Acoustic Guitar Making

How to Make Tools, Templates, and Jigs

Brian Forbes

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DEDICATION

To my family and my friends, who have always encouraged me to try harder and to do more.

FORWARD

Initially, it was never an idea of mine to write a book about guitar making. This all came from a small website that I created as well as a YouTube channel. After posting several videos under Six Gun Guitars online, I have had the pleasure of receiving thousands of emails from people who appreciated my work. Most of the emails were people just like me who had questions about how something was done, or how to accomplish something related to guitar making. It dawned on me all of a sudden that it would be a good idea to put all these solutions in one place where a person could reference them at any time.

So often when making an instrument and following a book, the text will say to "book match a piece of Indian Rosewood," and then go right on to the next step. If the reader has no idea what book match means, they will be lost right at the very beginning. Also, many books explain how to make the guitar but they do not explain how to make the jigs and tools required to make the individual parts. The tools, jigs, and templates are the most important part of guitar making because they lead to more consistent instruments, and less frustration when building. Knowing more about individual aspects of guitar making including theory, tool making, and finishing will lead to better made guitars and happier woodworkers.

Guitar making has been a passion of mine for over 15 years since I made my very first guitar when I was sixteen years old. At the time I wanted to buy a Jackson Explorer because James Hetfield played one, and if it was good enough for him then it was good enough for me. The problem was the price tag. Having a few tools in the garage and a father who was a machinist, I decided to buy a book on making electric guitars instead. Several months later and with some help from my father, I had an electric guitar similar to the one I wanted to buy. That was all it took to ignite a lifelong hobby, and a passion for woodworking that has produced many great sounding guitars.

I hope this book is as helpful to those who read it as I intend it to be, and I hope that it leads to building better guitars. If there are any questions about the subjects covered please feel free to email me, and I will do my best to get an answer sent back. Best of luck in all your guitar making endeavors, and feel free to send me some pictures of guitars that this book helped you to make.

Thank you very much, Brian Forbes

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DISCLAIMER

There is an inherent risk in using power tools as well as hand tools, and I insist that all precautions be taken while using these items and while working in the shop in general. These precautions include: using safety glasses, having some sort of dust removal in place, having proper ventilation, and using a dust mask or respirator. Also, it is a good idea to let someone know if you are going to be in the shop alone. That way they can check on you later in the day to make sure nothing happened while you were alone.

A tool that can cut through wood can cut through a finger just as well, and most accidents can be avoided by slowing down, paying attention to what is going on, and following all the recommendations by the manufacturer. Having a cell phone or house phone in the same room is also something that should be standard practice among wood workers. It will be hard enough to dial emergency while bleeding, let alone if you have to run through the house looking for a phone first.

The bottom line is that if a person does not know that much about wood working they should find a place that teaches these techniques before attempting them alone. If something looks to be beyond your skill level, do not attempt it. I take no responsibility for anything that happens by using the information provided in this book. There is a danger associated with using tools that is common to all of us, and that danger is the responsibility of the user alone.

If there is an error anywhere in this book, it is completely unintentional. I would ask you to please email me at westfarthingwoodworks@gmail.com, so I can correct the problem. The best tool we all have in the shop is common sense, use it often, and always pay attention. As a guitar maker our hands are our livelihood, common sense and attentiveness will help protect all of us from injury, and keep us in the shop.

to show any of the techniques to other guitar makers or wood workers who may have questions about the topics. Using the knowledge to assist other woodworkers and guitar makers is encouraged, as everyone does better when we all share what we know. However, any distribution of these materials for financial gain without my written permission is strictly prohibited.

Chapter One

MAKING BLANKS

There are several advantages to re-sawing guitar wood from pieces that can be purchased in a local hardwood store. The primary reason is that more than just the species of wood being purchased can be selected. When buying from an online source or a supply house, all that can be chosen is the species most times, and the actual set that is delivered may or may not look like the one from the pictures.

When purchasing a board from a hardwood store, the species, coloring, weight, tap tone, and many other factors can go into the choice. It is much more involved than just picking out a species and hoping for the best. A good hardwood store will have large bins that will require some time and effort to go through, but it will reward the patient guitar maker with the exact piece of wood they are looking for.

The second reason to saw blanks in the shop is that a premium is paid for wood that is already sawn and dimensioned. This extra charge is added on because the seller understands that the buyer either does not know how to do it themselves or they lack the tools to be able to make the cuts in the shop. What will be explained in the following several pages is that with a few tools, many blanks can be made in the shop rather than buying them already dimensioned. Though it may take longer to do it this way than to just buy pre-cut pieces, the satisfaction is in knowing every part was handmade, and that will make the difference.

The last reason that it is better to make blanks in the shop is because there comes a point where if too many of the parts are purchased already machined and ready to be glued in place, that it is not really guitar making as much as it is guitar assembling. There is something satisfying in being able to take a piece of 8/4 Mahogany that is 9” wide and 4’ long, splitting it open, sawing out neck, a set of sides and the plates, and making a complete guitar from that one board. It is nice to know that any piece of

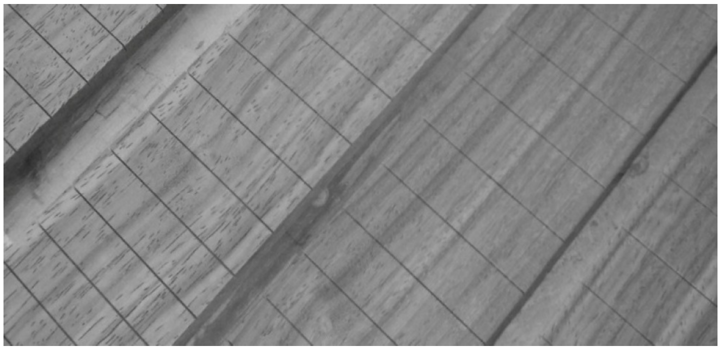
wood found in a hardwood store can be made into any part of the guitar desired, simply because the techniques for making these blanks are now known and can be done in the shop.

Wood suppliers simply charge more for boards that are cut to size and thickness because they have machines and man hours into the pieces. Having the knowledge makes it that much easier and more economical to make a great looking guitar without paying an extra premium for already cut wood.

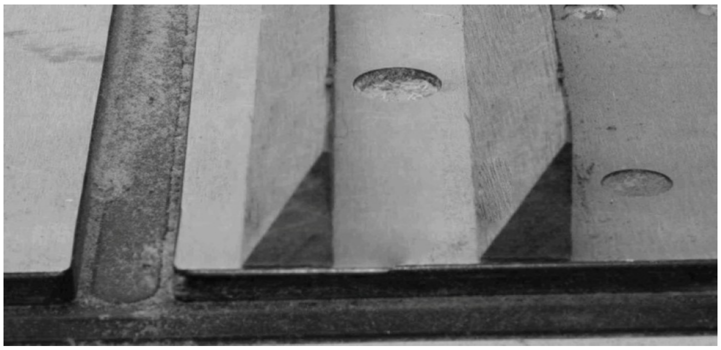
In This Section We Will Cover:

Re-sawing back and side blanks from store bought, standard dimension wood. See here.

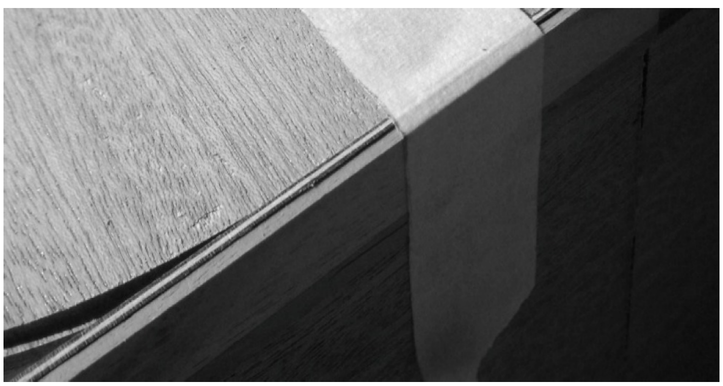
Making many bridge blanks from one large piece of Rosewood or any other species. See here.



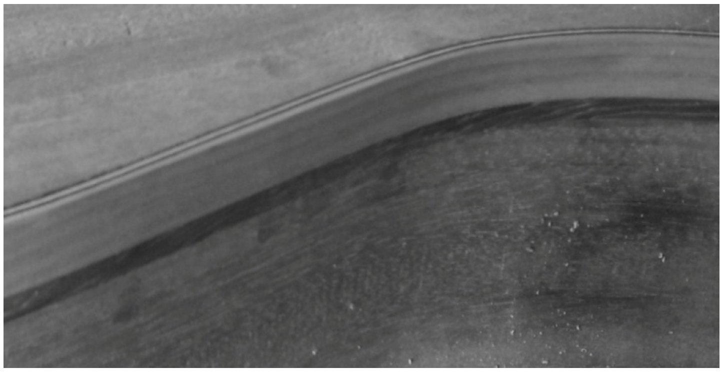
Sawing fretboard blanks from larger pieces of wood, and splitting wood for more yield. See here.



Making kerfing blanks on the table saw, which can be made easily and inexpensively. See here.



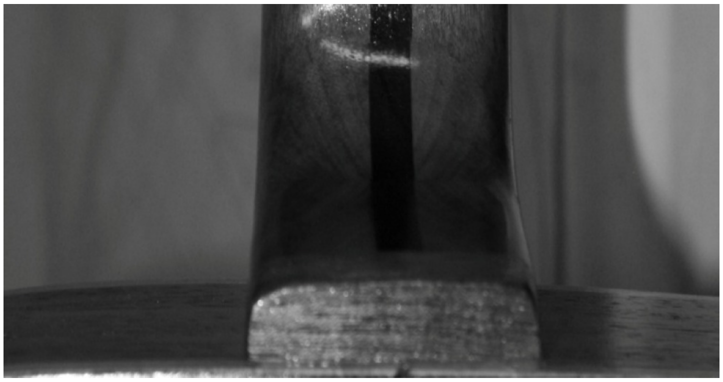
Cutting binding strips from a large piece of wood, and making dozens of them easily. See here.



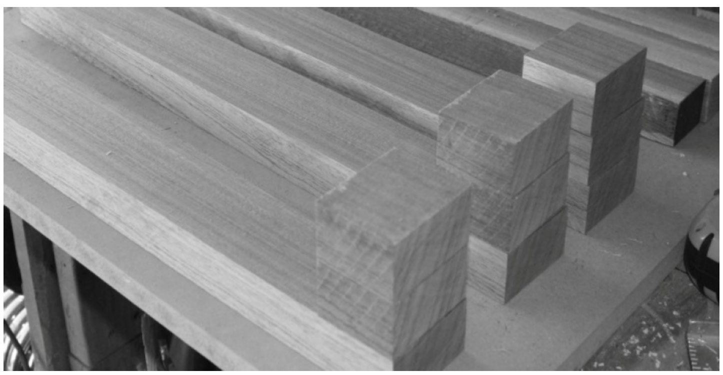
How to glue up and cut out laminated binding strips for custom hardwood binding. See here.

Shop made purfling strips and how to use veneer to make custom purfling. See here.

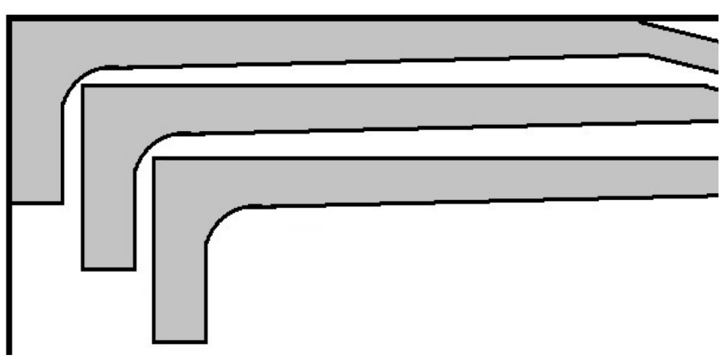
Making a laminated neck from curly maple, and how to get the best look. See here.



Laminated neck number two, with a different approach and the same classic look. See here.



How to glue up a stacked neck blank to conserve materials and make a strong neck. See here.



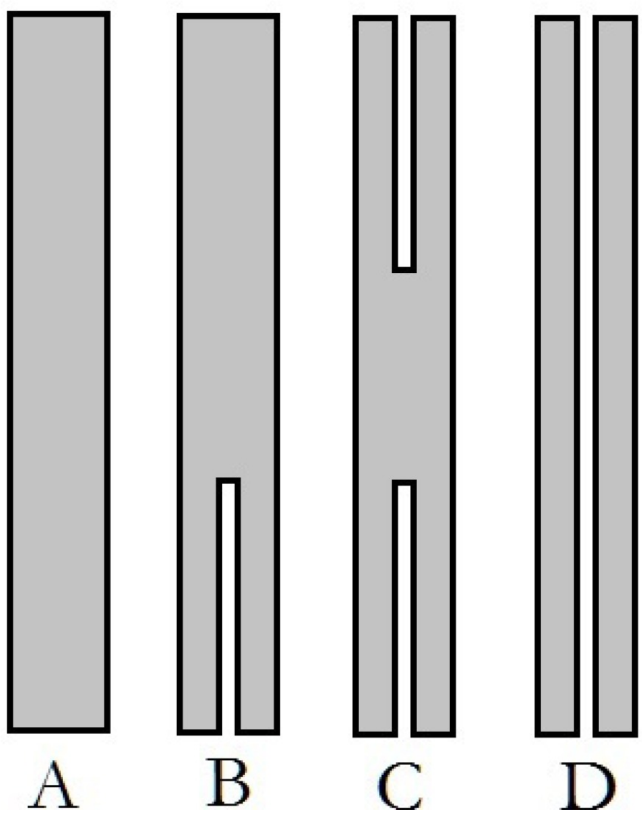
Stacked neck blank number two, using a neck profile and a single flat board. See here.

Standard blank sizes, and how to get more blanks from the same piece of wood. See here.

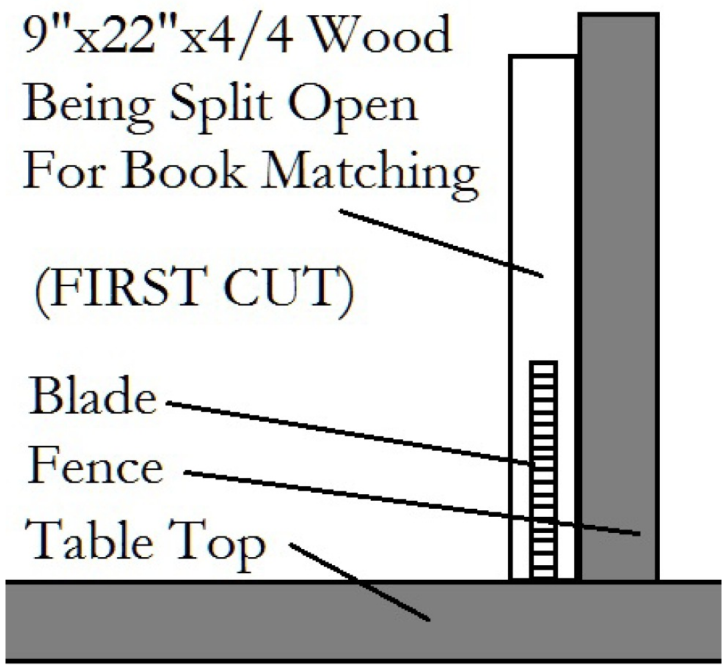
MAKING BACK & SIDE BLANKS

Most beginning guitar makers buy their wood pre-cut and dimensioned from a luthier supply house for their first few instruments. Until certain tools are purchased for the shop, that may be the only option. However, if a table saw or circular saw is available, it can be used to take a standard sized board from a hardwood store and split it open for a book match. A machine planer makes quick work of getting the boards down to final thickness, but a hand plane will do the same thing.

Most acoustic guitar plates are around 9” x 22” and are matched and center joined to form the back or the top. A board of the above dimensions is split open along the edge, and folded open the same way a book is opened. This leaves a grain pattern that is a mirror match over the center line.


A
B
C
D

An overview of the steps involved is in the above diagram. The view is of the 9" end of the board, and board A is where the process starts. The first cut is made on the table saw, resulting in board B, with a deep cut on one side. Keeping the same face of the board against the fence, a second cut is made on the other side resulting in board C. A hand saw or reciprocating saw is then used to remove the last bit of waste in the middle, which finally splits the piece in two, like board D.

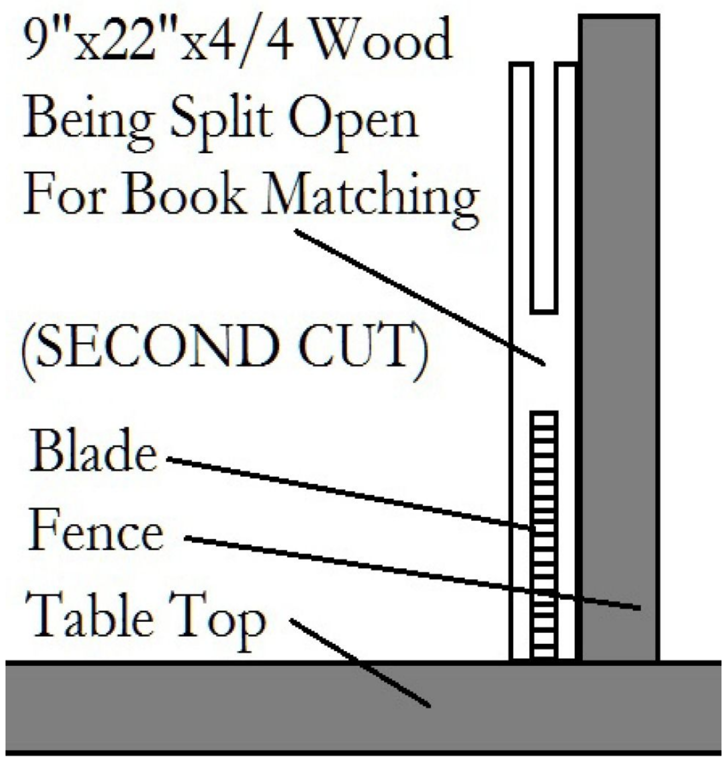


The first cuts are made either using a table saw or circular saw. These are made at the maximum depth that the saw will allow, and will go from end to end. The table saw must have the blade guard removed before making this cut, because the saw will not go completely through the wood like normal. The blade guard only functions when the piece being cut is shorter than the height of the blade. If the riving knife sticks out above the blade at all, remove it as well before making these cuts.

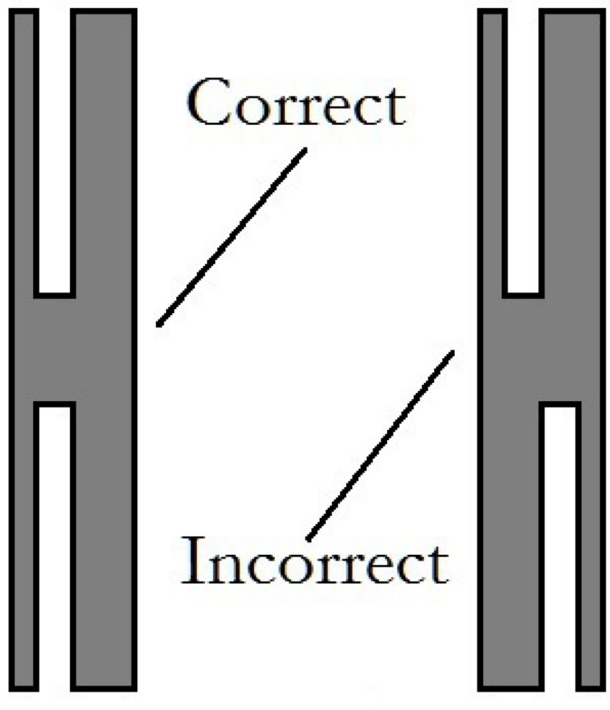
If using a circular saw, clamp the board tightly against a bench with the edge level to the top, and carefully saw through the board following as close to the center as possible. The circular saw method is best done with the wood clamped against the bench rather than in a vise, because the bench top can be used to rest the saw against. Trying to saw on

the edge of a board while it is sticking out of a vise is dangerous, and may result in injury.

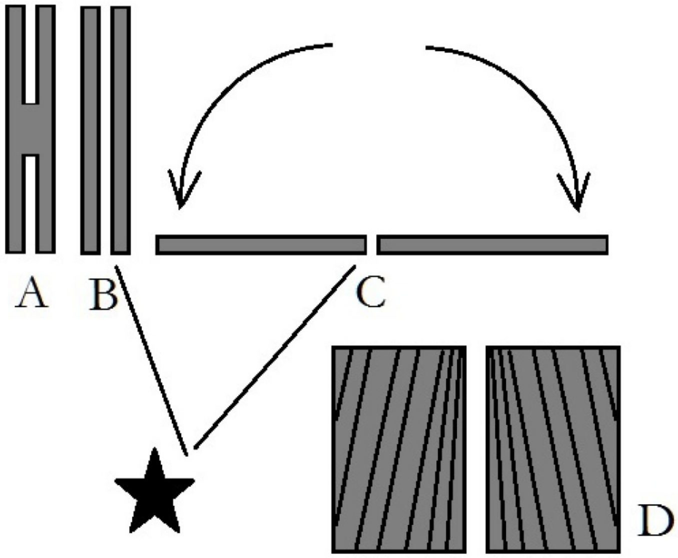
Go slowly with either method because the large amount of wood being removed can cause the saw to bog down. On harder woods set the depth of the cut to half the maximum and make one pass before setting it to the full depth and making a second pass. It is always a good idea to split the cut into a couple passes, because it reduces the chance of kick back, and blowing a fuse on the saw.



The above diagram shows the second pass being made on the piece of wood. It is very important to keep the same face against the fence on both passes, which will keep the two cuts lined up together, making the following steps easier.



The above diagram shows what the piece would look like if the cut were way off center. The board on the left had the same face against the fence, so the cuts line up well, making it easy for the hand saw or reciprocating saw to cut through the remaining material. The piece on the right did not have the same face against the fence, making the slots uneven. This may be impossible to saw through in the next step, which makes the piece unusable.

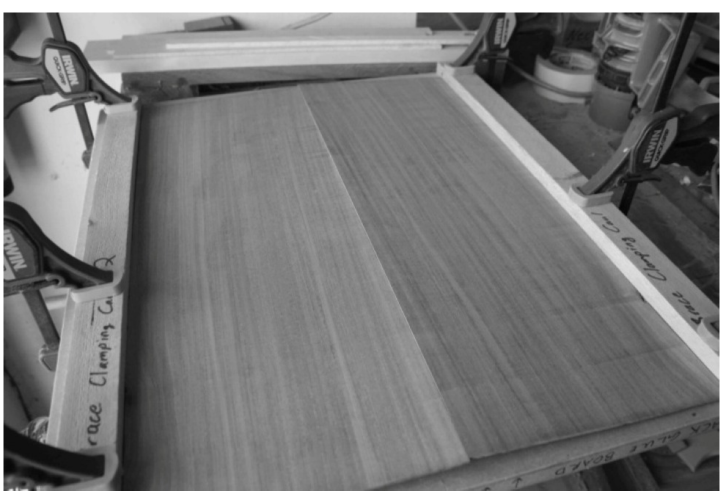


After the first two preliminary cuts have been made, the waste wood in the center will need to be removed. This can easily be done by clamping the piece in a vise, and using a hand saw to finish the middle portion. It will take time, sweat, and sore muscles, however it will work. The cuts already made by the power saw will act as guides to keep the hand saw lined up and cutting straight.

An alternative method for those who own a reciprocating saw, is to use a long wood cutting blade to reach the center waste area. The piece can be held in the vise again or clamped to the side of the bench, and the reciprocating saw will power through the piece in a small amount of time.

Once the two pieces are split open they will need to be planed to thickness using either hand planes or a machine plane, which will make the job much faster. A machine planer is one of the best investments that can be made by a guitar maker, because it makes a very long and difficult task quick and easy.

This method can be used for guitar sides as well as the plates, though most table saws can handle the depth of the sides without having to cut out the center portion afterwards. This method can also be used to split thicker pieces of wood to make bridge blanks, fretboard blanks, and binding strips, which will all be discussed later.



Most guitar catalogs charge two to three times the price of standard lumber for a back and side set already dimensioned. For the same price, the wood for an entire guitar can be purchased in a hardwood store. Also, the fact that all the wood is from the same board will mean all the pieces will match for color and grain. Most catalog backs are sawn at the mill from different logs than the sides, and they are later matched based on color and sold as a set. No matter how much they try however, there is no better match than a back and side set from the very same piece of wood.

Project Notes:

The main reasons to make as much as possible in the shop is to increase general woodworking abilities and increase the range of wood that can be used to make any part of the instrument. It also makes much more of the guitar handmade, where less pieces are bought ready to assemble. Most people can put parts together, though it takes a special talent to know how to make each and every wooden part.

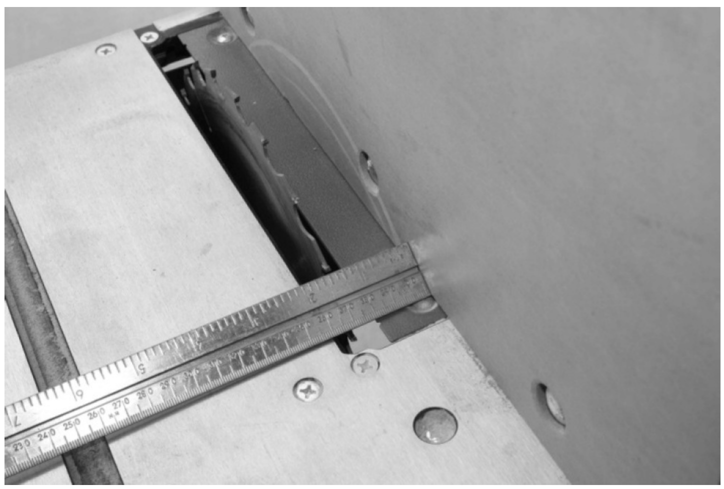
Making blanks in the shop expands the available wood choices to the guitar maker. When any piece of wood can be effectively split in two and made the proper thickness, the amount of choices that are available increase dramatically.

Odd items that look beautiful like Briar bridges, or Bocote fingerboards are now available because they can be cut and shaped in the shop. It may have been impossible or very expensive to find these online or in a catalog, and now they are available any time they are needed.

Finally, re-sawing in the shop means more of the guitar was handmade, and less of it was bought ready to assemble. This will not only save money, but also create a better woodworker in the process.

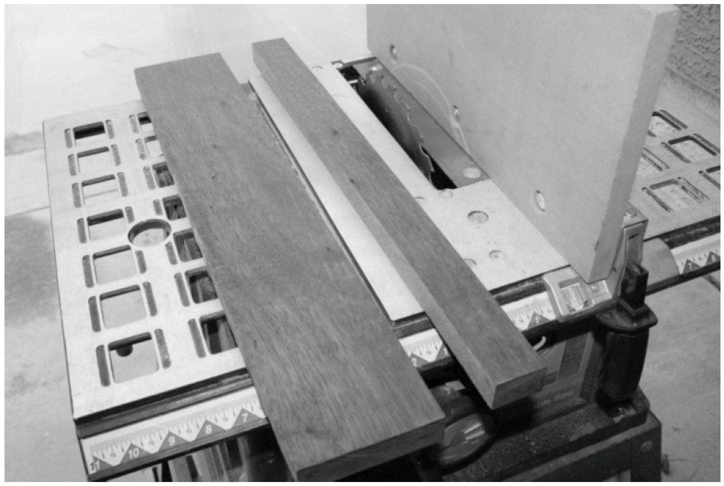
MAKING BRIDGE BLANKS

Of all the guitar making blanks that are probably the most overcharged for, the bridge blank ranks right up there at the top. A small piece of Indian Rosewood or Ebony has an actual cost that is very low when compared to the price to buy one already cut. A single piece of Indian Rosewood will be large enough to make several blanks, and they are very easy to cut out in the shop.



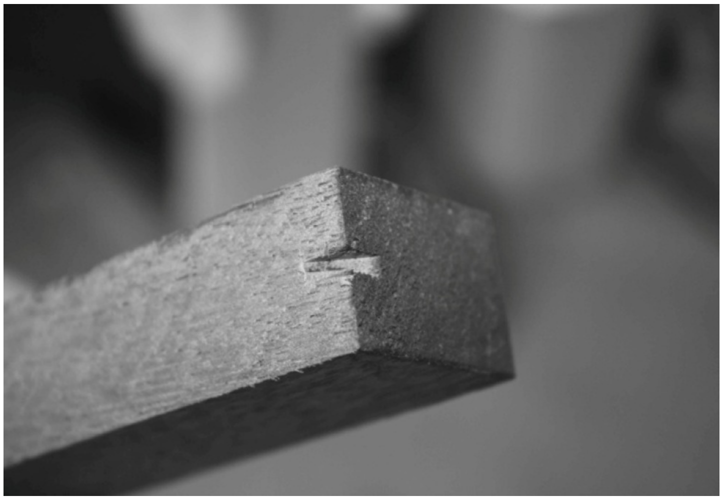
Set a fence on the table saw that is as wide as the bridge blanks will need to be, which in most cases 1-1/2" will be perfect. Check the measurement with a ruler to be sure that the blade is in correct position, and lock the fence in place.

This can also be done with a band saw and a piece of wood clamped to the table top which will serve as a fence. Bridge blanks as well as fretboard blanks are not very tall, which means they can be sawn through even on smaller band saws without any problems.



Rip cut a piece of 4/4 Indian Rosewood, Ebony, or in this case Mahogany from the edge of the board. If several blanks are going to be made from this one board, rip as many strips as possible.

Move the fence closer to the blade so it will cut through the middle of the pieces when stood on edge. This will split them open, doubling the number of bridge blanks from a single piece of wood.



Turn on the saw blade and knick the edge of the board to check that the saw is tracking in the middle. If it is not, move it and try again until it is right.

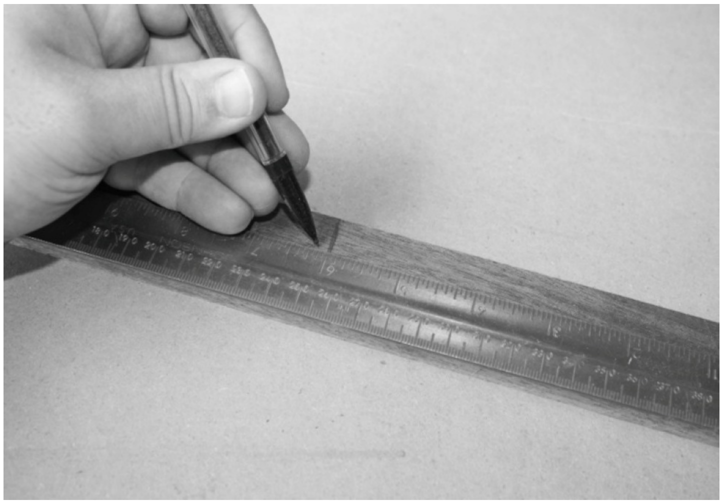
Once it has been verified that the saw is cutting through the middle, or at least very close to it, the piece can be ran through the saw completely, splitting it open into two pieces. Each one of these will be thick enough to use as a bridge blank, meaning less wasted wood and more usable bridge blanks from the same piece of wood.

Here is a view of the pieces of wood once they have been split open on the table saw. Again, this can be done on the band saw, or with a jig saw, producing the same results if careful.

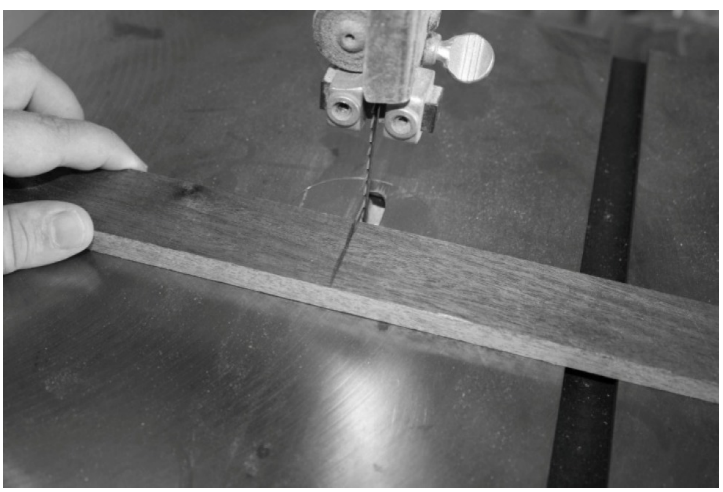
Feed the pieces through a planer until they are the proper thickness for blanks, which will vary depending on the set of plans being followed, and personal preference. Most blanks will be anywhere between 3/8" thick and 1/4" thick.

If a planer is not available, there is nothing to worry about in this case. If the piece that was used to make the blanks is bought with planed faces, the top and bottom will be flat. Split the piece open and let the faces of the board become the new bottoms. They will be flat, just as if they were sent through the planer in the shop.

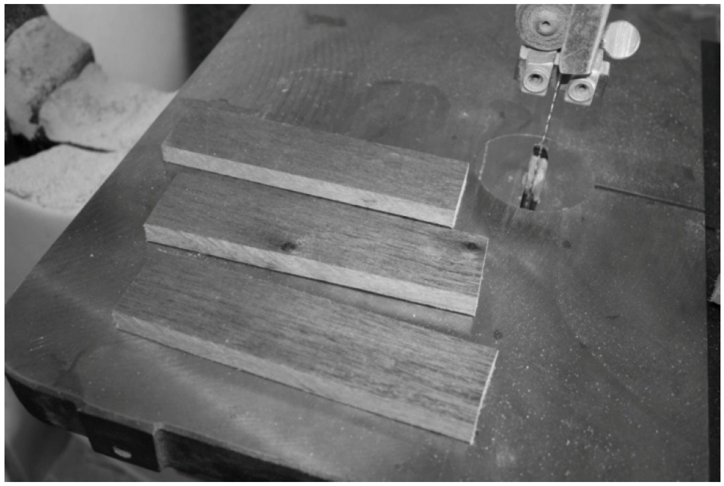
The tops of the boards can be leveled roughly with a hand plane, and once the final carving and shaping are done it will all work out well. Do not spend too much time working on the tops once they are close to flat because it will all end up being carved off later anyway.



Measure the length of the blanks with a ruler, and mark them out along the piece. A 6" blank is typically perfect size for most guitars.



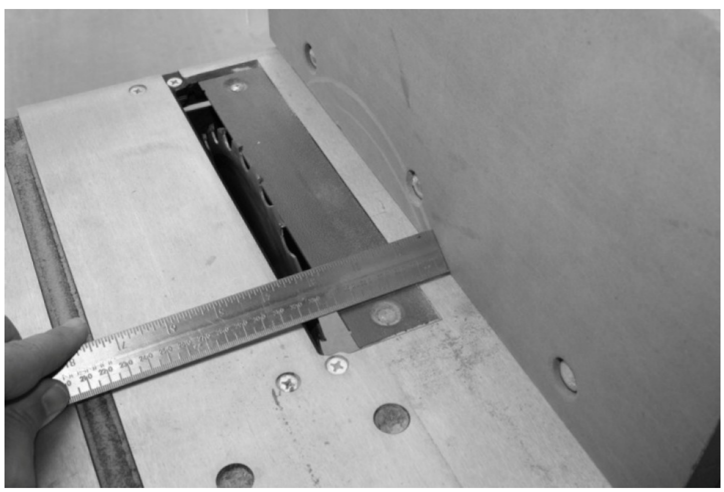
Cut the blanks out on the band saw or the table saw, carefully following the marks.



Once all the pieces have been cut into blanks they can be stacked for storage alongside the rest of the wood in the shop. When a bridge is needed, several of the steps have already been completed, and a much less expensive piece of wood is ready to become a great guitar bridge.

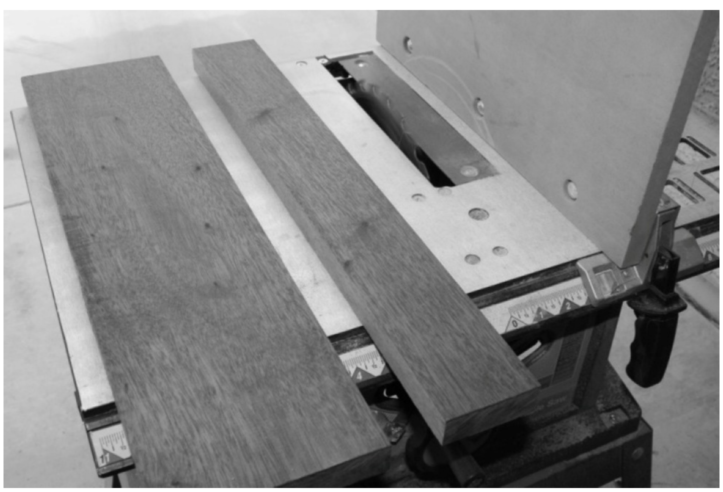
MAKING FRETBOARD BLANKS

Making Fretboard blanks is another easy project that can really help expand the ability to make a custom instrument. Most companies sell two kinds of fretboards, Ebony or Rosewood. That gets really old really fast, especially when there are so many interesting species out there to choose from. Being able to cut and create fretboard blanks means that any species of wood can be used to make a very interesting guitar. The only real limiting factor on a fretboard is the density of the wood. Harder woods make better fretboards in general, so make sure to select a denser species when selecting a piece for a fretboard.



Measure and mark out the width needed for the fretboard, which is usually around 2-3/4", leaving enough to be trimmed down later. Measure and set the fence of the table saw with a ruler, ensuring that the blanks come out accurately.

The board to be used for the blanks should be any 4/4 piece of hard wood that measures at least 20" long, which will leave a little extra on the end to be trimmed after the fretboard is laid out. When making a fretboard, there is more room for expression with less chance for negative consequences. If an interesting species of wood is tried as a fretboard, there are fewer things that can go wrong with the choice, especially when compared to using the new species as a top. There are so many interesting species out there that it is a shame to only use Indian Rosewood or Ebony for everything.



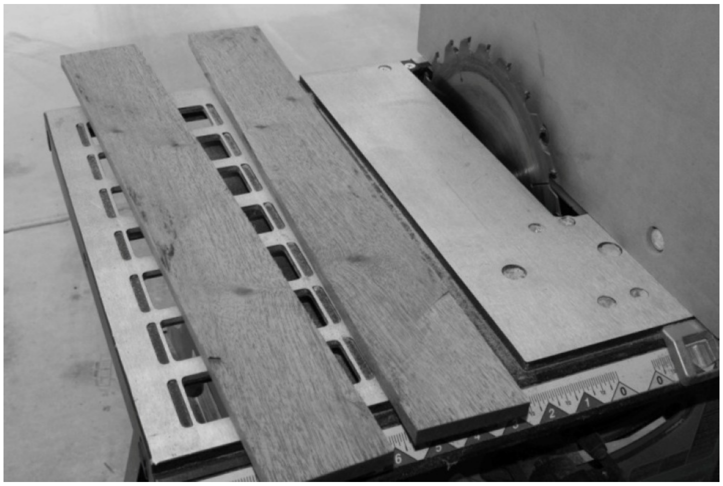
Run the piece through the saw, keeping it tight against the fence the whole time. Use a push stick and a feather board if desired to help make

the process as safe as possible. If making several fretboard blanks, rip all the pieces to width at this point before changing the saw settings.

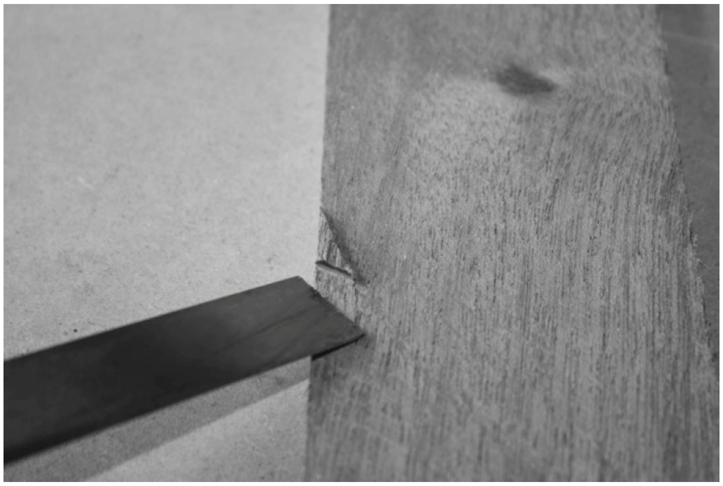
Move the fence closer to the blade, and lock it in place where the blade will cut through the middle of the piece when stood on edge. Set the blade to half the height of the piece, and make two passes to separate it.

Check this lineup several times to make sure the blade is straight and centered in the middle. Since the final thickness of the fretboard will be around 1/4", if the blade is a little off it will not ruin the piece, however it will make for more planing to flatten it later. The better the cuts early on, the easier the rest of the process will become.

Knick the edge of the piece by turning on the table saw and advancing the board into the blade a tiny bit. This way, the centering can be checked one last time before sawing the piece through.



The picture above shows the pieces after they have been split open.



Sometimes when swing through, the piece may be stopped early to prevent having to hold onto it while the saw blade is moving. When it is, there will typically be small chunks of wood still attached to the faces in some areas, which will need to be removed. A chisel makes short work of removing these small pieces of extra wood, which is important to do before sending them through the planer. If a larger chunk is not removed, it can

catch on the way into the planer, stopping the piece, and potentially ruining it if the blades cut too deeply.

With any large saw remainders removed with a chisel, the pieces are ready to be sent through the planer. The normal thickness for a fretboard is 1/4", though if the plans being followed or the preferred size is different, simply plane the pieces until they are that thickness.

At this point the blanks can be taken to the fret slot duplicating jig that is described in chapter two, and the fret slots can easily be placed. Once several blanks are made, the process is very easy to select one, saw the frets, and begin the shaping and fitting process.

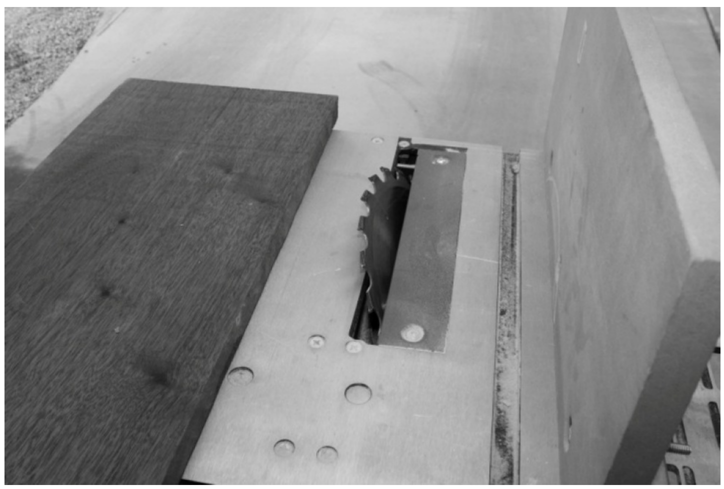
Making fretboard blanks instead of buying them opens up a whole world of wood choices that were otherwise closed. A great looking and vibrant piece of wood that is found in a hardwood store can now be used to make a fretboard, instead of having to select from what is available through a guitar supply company.

Try out a few different pieces of wood and see how they look as a fretboard. Since the process for making the blank is fairly easy, several different species can be sawn and tested to see what they would look like on a finished guitar. Species including Padauk, Bocote, Bubinga, Black Walnut, Purple Heart, and Goncalo Alves make excellent fretboards, and each one of them leaves their own personal mark on the look of the guitar.

Any one of them are a far more interesting choice than Rosewood or Ebony, though the process would work the same for either of those woods as well.

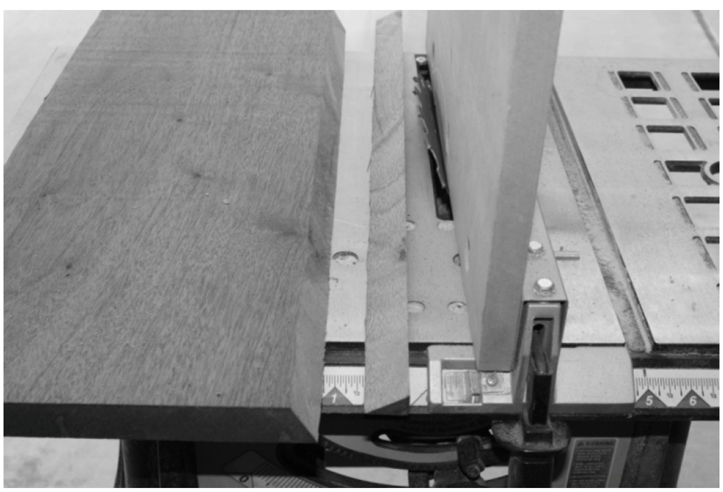
KERFING BLANKS

Kerfing blanks are one of the easier items to make at home, and will save much over buying them from a catalog. A table saw is the easiest way to make these blanks, and they can be cut from almost any size piece of wood that is 4/4 thick. For the same price as enough strips to do one guitar, a board can be purchased that will give enough strips to do four or more guitars.

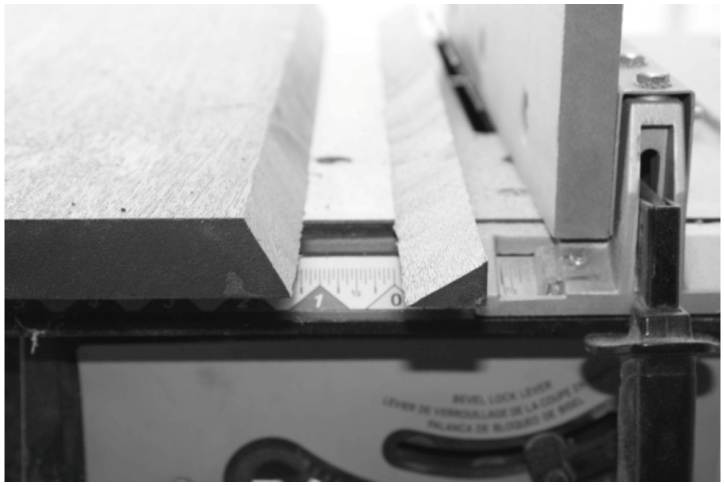


This style of kerfing will begin with a 30 degree angle cut along the entire strip. In this way all the strips will have a 30 degree taper to them, which can be left as a triangle or trimmed flat as shown later on in the process.

The board to be used for making the blanks does not need to be as long as the kerfing blanks sold in the catalogs, because when installing kerfing it is often broken into smaller segments for easier gluing around the rim. A piece that is at least a foot long makes the process worth it, any anything longer will make bigger pieces that will end up being cut down later on anyway. Test the lineup of the saw and the fence so that the blade will remove a 30 degree strip, leaving a sharp corner at the bottom.



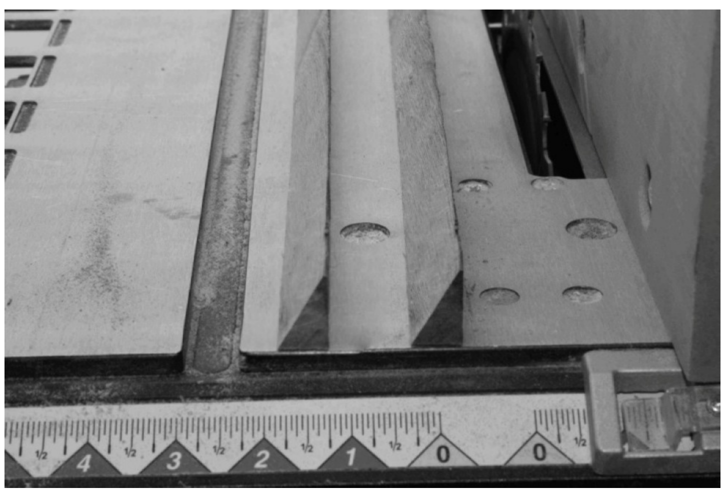
Rip the first strip off the edge of the board, and set it aside where all the strips will be gathered.



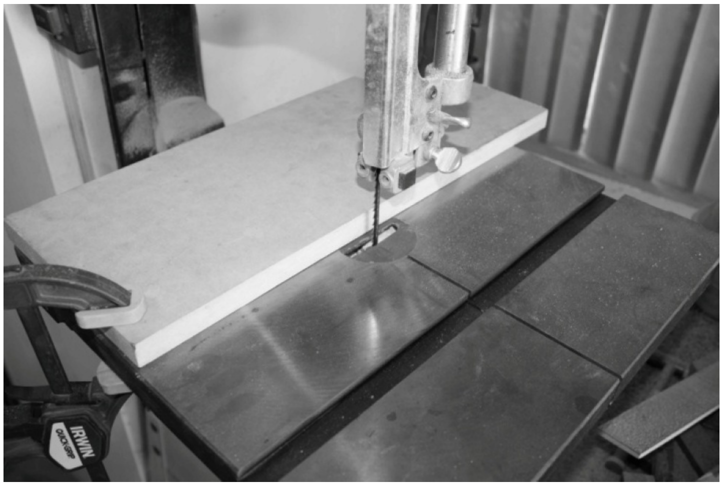
The shape of the strip can clearly be seen in the edge view picture above. Notice how the saw blade did not cut through the tip of the strip at all, which would reduce its height.

Tilt the blade back to 90 degrees, and flip the piece of wood over. Position the fence to cut through the wood again, removing another binding strip blank from the edge.

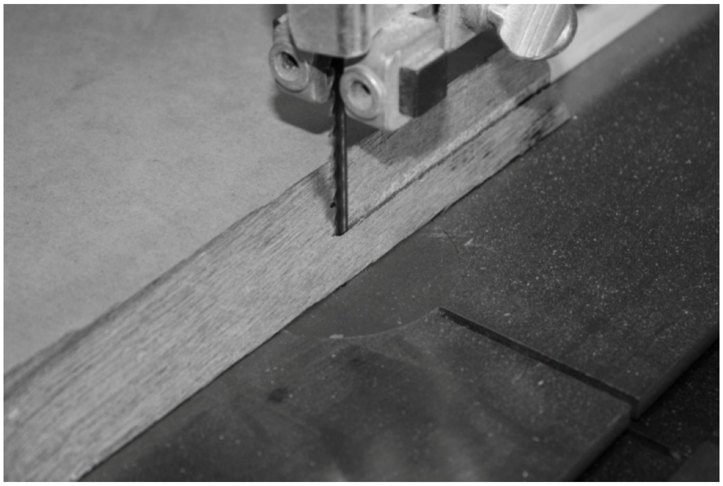
The edge view here makes it easy to see how the second strip was removed, leaving a flat edge again on the main board. Also, the strip is the same height as the board, making all the strips uniform.



Here are the first and second strips next to each other. Pile up all the strips in one place as they are cut, going through the entire board this way.



Once the table saw portion of the process has been repeated until there is not a wide enough piece left to safely cut strips from, gather the strips and go to the band saw. Clamp a piece of wood to the table top that will serve as a fence, and measure it so that the blade is 1/4" from the edge of the wood. This will make strips that are 1/4" thick when passed through the saw.



Stand the strips up the tall way, and place the larger flat surface against the fence. Turn on the saw and send the piece through, reducing the thickness to 1/4". If thicker kerfing is desired, adjust the fence to leave the pieces a little wider.

When viewed from the edge, all the kerfing blanks should now look like the picture above, a 30 degree bevel with a flat face. The larger of the two flat areas will be glued to the guitar sides when the kerfing is installed. At this point the height can be reduced with the band saw and a stop if a shorter piece is desired, however a strong rim helps make a good sounding guitar.

After the pieces have been cut, they will need to have the kerfs cut into them, which will allow the strips to flex when they are installed. Follow the directions for the Kerfing Jig in chapter two and a very easy way to kerf the strips can be made for use on the band saw. This process does take time, however it is far more economical than buying pre-made strips.

MAKING BINDING STRIPS

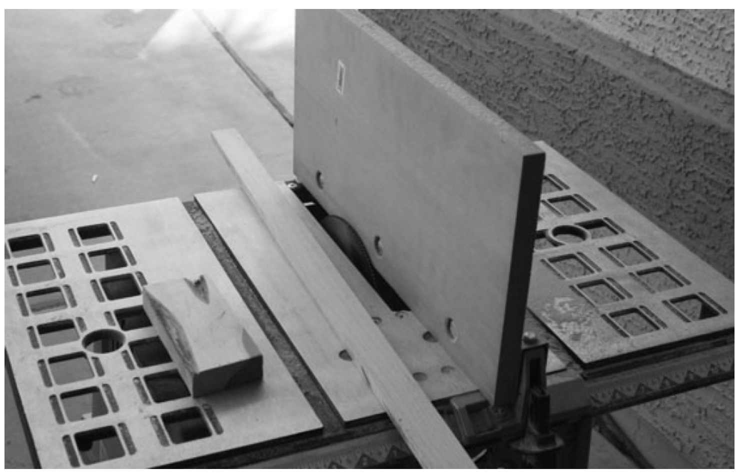
Making binding strips is a great way to stock up on guitar making materials that will be ready to use when needed. The process requires the same tools that most guitar makers already have in their shops, and the time required is minimal. The real savings comes in the cost difference between store bought binding strips, and shop made strips, which are around 1/10 the price. Plus, these strips can be made from any species that bends well, like Mahogany, Maple, Padauk, Goncalo Alves, or Walnut.

When selecting a piece of wood to make binding strips from, make sure to note the grain orientation. Since we are going to be ripping strips off the edge, a piece of flat sawn wood will yield quarter sawn strips. Get a piece that is around 5"-6" wide and at least 36" long to begin with. It can be 4/4 or 8/4 since we are going to run it through a planer to bring it down to size. If a planer is not available purchase a piece that is close to final strip height, around 3/8".

Since the top edge of the binding strips will be scraped away after it is glued to the guitar body, planing the wood to thickness does not have to be as precise as in other operations. If a table saw is only available, set the blade to the maximum depth and check the straightness with a square. Run the piece through and split it exactly down the middle, similar to book matching. Then flip it over to get the other side if necessary. This will leave a relatively flat surface where the blade went through, and there will still be one factory flat side to use. This will take the piece from a thickness of a little over 3/4", to being two pieces with a thickness of about 3/8".

The final piece that will be cut into strips should measure around 5"-6" wide, 36" long, and about 3/8" thick. There should be at least two of these after splitting the main piece open.

If a thickness planer is available, run the pieces through until they are a uniform thickness of 3/8", taking shallow passes to avoid tear out. This is an optional step before beginning the process.



Using a finishing blade with a higher number of teeth than a standard blade, set the fence on the table saw to less than 1/8" but more than 1/16". The closer to 1/16" the better, as long as the pieces exit the saw fairly smooth on both sides.

Usually the first couple of cuts produce pieces of uneven thickness until the board gets a nice straight edge on it. Discard these first few pieces if they are like that. Go slowly enough to control the piece and keep it against the fence, but quickly enough that the saw blade does not

burn the wood too much. A little burning is unavoidable though, due to the tight quarters in which we are working and the type of blade.

Once the strips start coming out nicely, begin collecting them in a separate area away from the bad strips, as it will become easy to confuse them once a whole pile has been cut. Finish cutting strips until the blank becomes too skinny to safely keep sending through the table saw. At this point if a zero clearance insert is available, a few more strips can safely be taken from the main piece.

If a zero clearance table saw insert is not available, one can easily be made with a scrap board and some clamps. Position the scrap piece very close to the saw blade without touching it, and clamp it in place like in the picture. This will allow the skinnier blank to be sawn without falling through the wider throat gap in most table saws. Be careful as the piece gets thinner and the fingers get closer to the blade. A push stick is recommended, and it is better to scrap a couple inches of wood than to risk getting too close to the saw.

Gather up and inspect the newly sawn strips and discard any that are not a uniform width, that have excessive burning, or areas where the blade has damaged the strip. The amount of burning seen in the picture above is what would be called normal. Since a finishing blade was used, the sides that will be against the guitar when installed are nice and flat. No further treatment of these strips is necessary other than bending before installation.

If the burning is bothersome, the pieces can always be sent through a sander or worked through a drill press mounted sanding jig until they are the desired thickness. The mini-drum can be bought in any hardware store, and the spindle sander jig is described in chapter two.

A good storage option is a gutter made from wood that keeps all the binding strips in one place and sits on a bench out of the way. There are at least a dozen strips each made from Maple, Padauk, and Goncalo Alves in the bottom picture in the left column. This would be a high dollar amount of binding strips if they were bought from a supply house, but since they were made in the shop the only cost was the piece of wood.

Another good place to store them where they can be kept flat and out of the way is inside a piece of PVC pipe. A piece that is 2" in diameter or more and 36" long makes a good storage option. Cap the bottom end, and insert all the strips standing up.

Project Notes:

Binding and purfling strips are some of the most expensive parts of the guitar when looking at how much the cost of the actual wood is. Very thin strips of wood are inexpensive to make, however they are very expensive to buy. The reason they are so expensive is most people have no idea that they can make the strips themselves.

For the cost of a fine tooth saw blade and a zero clearance insert, hundreds of binding strips of different colors and species can be made. At an average cost of a few pennies each, there is no reason not to make the investment in the shop and start making binding strips.

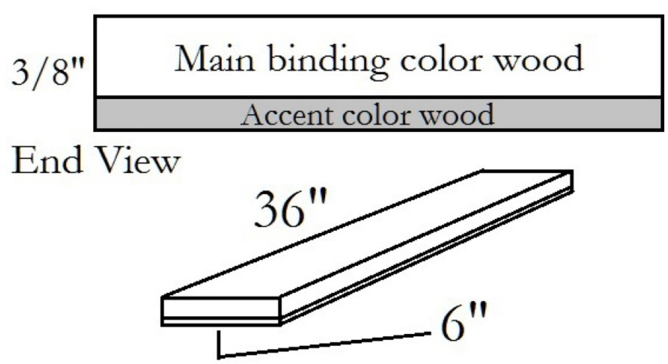
Very thin strips can also be cut for bending into rosette inlays as well. If making a very colorful or concentric ring rosette, cut a few

strips a little thinner than those being used for binding strips. A thin strip will be easier to bend on the iron, and can be made into very tight circles that can be inlaid around the soundhole. Regular sized strips will bend too, though sometimes it is difficult to get them to make as tight of a curve as will be needed around the rosette.

LAMINATED BINDING STRIPS

Another interesting thing that can be done when making binding strips in the shop is making them from laminated pieces of wood. The process is similar to standard binding strip making, but with one difference. The blank is made with a contrasting piece of wood glued to one side, and when cut into strips it will show as a thin accent line.

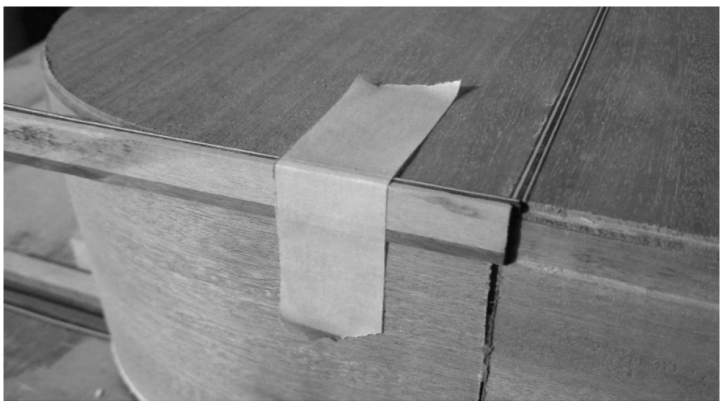
The advantage of using a pre-glued binding strip is in the ease of installing them. If an accent strip is used that is separate from the main strip, it will have to be bent and glued in place itself. The regular binding strip will also need to be bent and glued, meaning twice the work for the same results.



The first step is to prepare the blank for cutting into strips. The overall blank dimensions need to be 36" long, at least 6" wide, and around 3/8" thick. The length dimension allows for a couple extra inches just in case some pieces are nipped by the table saw, and need to be trimmed. The width can be wider and will result in the ability to cut more strips from the blank. Six inches is usually the minimum width, just because a very skinny piece will not give us as many binding strips before it becomes too thin to safely cut anymore. The height can vary depending on how thick or thin the binding will be in the end. Also, the accent piece can be as little as 1/16" or as much as 1/8", so the choice is up to the builder. On the binding strips shown in the pictures, the height is a little over 3/8" so there will be some room to scrape them level once they are installed.

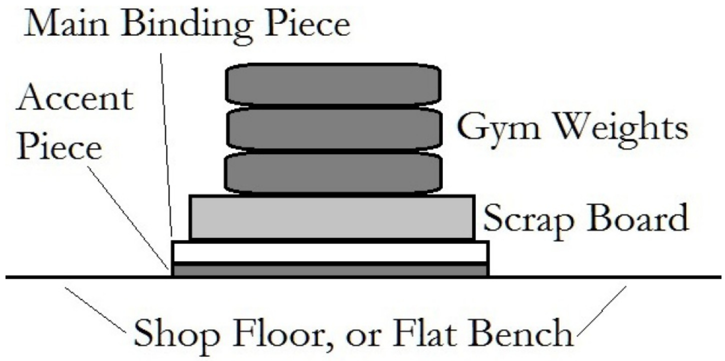
Prepare the thinner piece first by running a 36" x 6" piece of wood through a planer until it reaches the final thickness desired. If this piece starts out 4/4 thick, follow the instructions for splitting it open earlier in the chapter, to avoid wasting too much wood on the planer. A piece of veneer can also be used for a very thin accent line if desired.

Select a piece for the main color of the binding strip, and cut it to 36" x 6". Run this through the planer as well until it reaches the desired thickness, usually 2-4 times the thickness of the thinner piece, or about 1/4". Once both of these pieces are down to the right thickness, they can be glued together.



Lay the thicker piece on top of the thinner piece and check for any gaps or problems with the mating surfaces before gluing them. If they look good, glue them together on a flat surface, using weights as clamps. The glue for this can be standard Titebond, or for some added protection Titebond III. All of these strips were made using Titebond Original.

A garage floor is perfect for this kind of work and will keep the resulting glue-up flat. Sweep any debris off the area where the pieces will lay, then find a scrap board to be used as a clamping caul to spread out the pressure evenly. Glue the two pieces of wood together to make the binding blank, making sure to coat the mating surfaces completely without any gaps. Lay this on the floor of the shop, or on another flat surface, and lay the scrap board on top of it. Using gym weights or heavy objects from the shop, weigh down the board, effectively clamping the piece together.

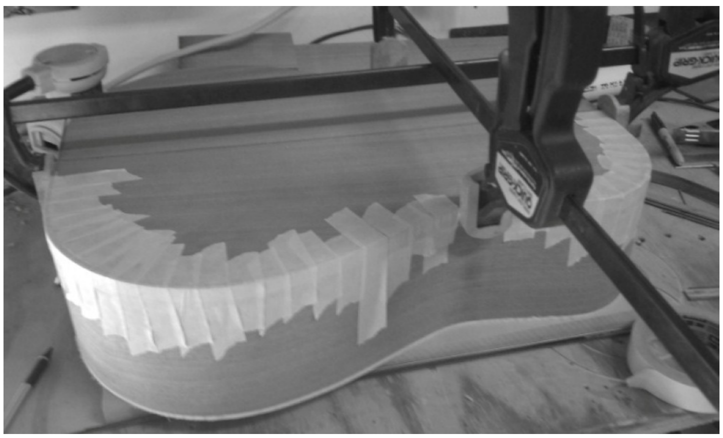


The diagram above shows how the layering will go, and anything can be used for weights as long as they are heavy. I happen to have a large number of gym weights in the shop, and anyone who has ever seen me knows that I do not use them for their intended purpose. They do however make excellent clamps for very large items that are sometimes hard to get a hold of with regular clamping methods. Gym weights in varying sizes from 5lbs. to 25lbs. are compact, easy to move around, and useful for many clamping duties. Laying many of them over a surface is a low tech version of a vacuum press. Though it is not as fancy, it does get the job done.

The strips will have to be bent before installing just like any other strip, however a little caution has to be used when doing so. Getting the strips completely soaked in a trough for hours before bending can result in the accent strip falling off of the main strip. The glue will break down over time under water and all the work will be for nothing. Also, leaving

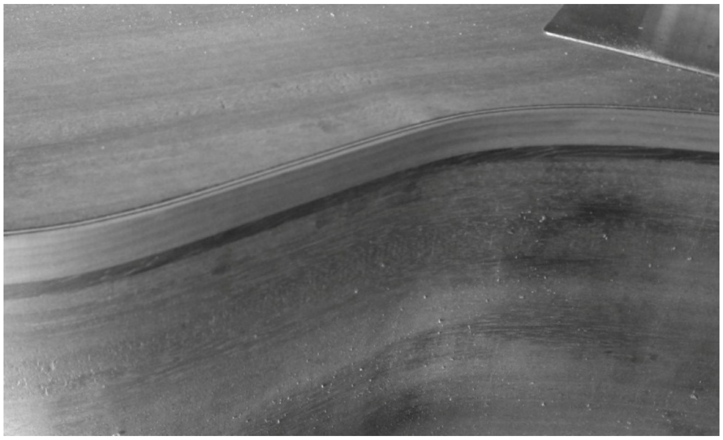
the strips on the iron for too long will break down the glue bonds, and cause the strip to fall apart.

If it is easier to bend the wood wet, spray the pieces with a spray bottle before bending them rather than leave them under water a long time. Once wet, the pieces will steam rapidly under the heat of the pipe, and bend just fine. Do not delay too long on the pipe, and as soon as the strips start to flex, go ahead and make the bend. This way the heat from the pipe does not separate the strips.

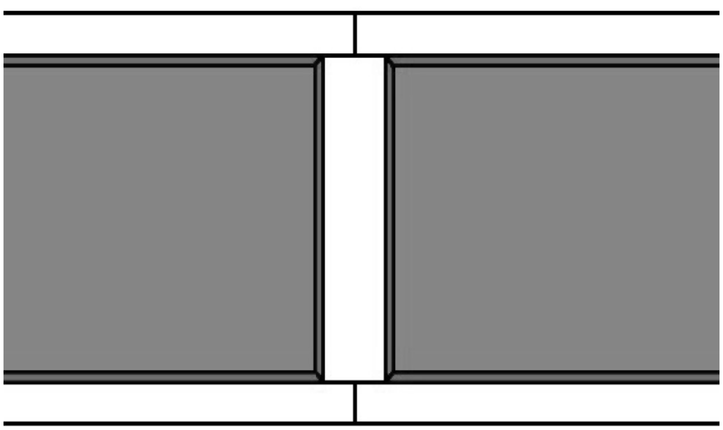


Also, the strips do not need to be bent perfectly to the exact shape of the sides of the guitar to work well. The waist bend needs to be as close to dead on as possible, but the rest of them just need to be close. The binding tape (masking tape) that is used to clamp the strips in place while drying will pull the braces into the correct position and solve any small bending issues.

Having bent several of these before, the separation has never been an issue. Leave a strip on the pipe a long time and eventually it will come apart, though it does take a while longer than required to bend it.



Once the binding is installed, the small accent line will really stand out and give the guitar a nice look without that much more effort. Depending on the species chosen, the look can really be exotic. Flashy choices include Padauk (pictured), purple heart, and blood wood. Each of these gives a bright accent color that is hard to miss.

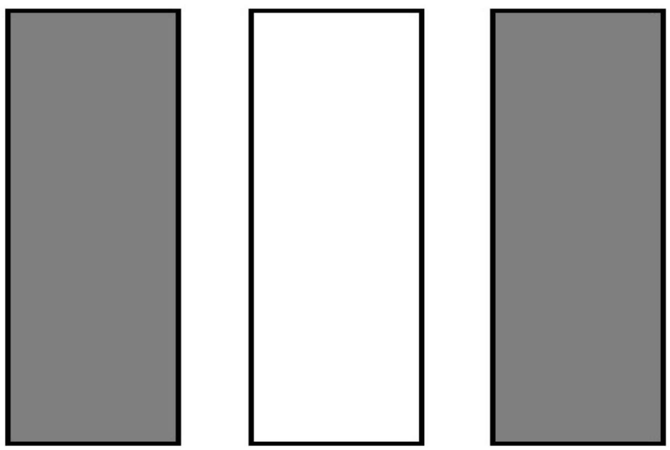


The above diagram shows the bottom end of the guitar with the end flash in place and the two tone binding trimmed and mitered nicely. The main binding color, shown here in white, does a nice job of framing out the darker sides, which it does on every guitar that is bound. The accent however does the same thing, again framing the darker sides but also giving another layer of contrast to the binding. This produces a double framed look that really sets off a guitar. The ends of the accent are neatly mitered in the corners, making a clean look.

SHOP MADE PURFLING STRIPS

One of the most expensive and severely overpriced items that a guitar maker will require are purfling strips. They contain nearly no wood, are simply thin strips glued together, and yet they sell for high dollar in the catalogs. If a table saw is available in the shop, purfling strips can be made for less than a quarter of the price of buying them.

The advantage to making purfling strips in the shop is that several different variations can be made to suit any style of guitar. Any species of wood that can be found in a veneer can be used to make purfling strips, which means there will be more options than simply black/white/black fiber strips.



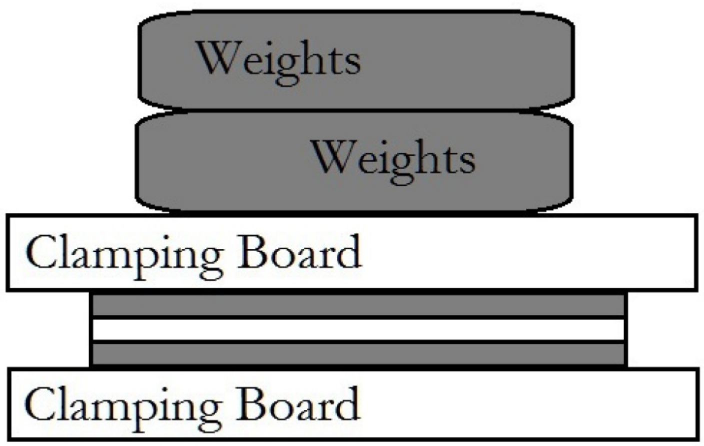
To make the strips, several pieces of veneer will be needed, in a couple contrasting colors. The width of the pieces is not as much of a concern as the length, which will need to be 34" at least to make it half way around the guitar.

Select a couple species that have a large amount of contrast between the two of them, like Walnut and Maple, or Rosewood and Birch. If making the standard black/white/black purfling strip, use the darker color on the outside and the lighter color on the inside.

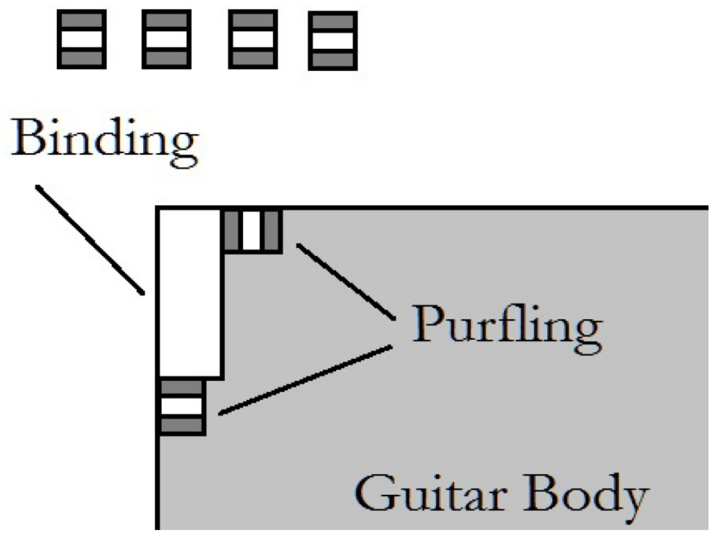
There are several places that sell veneer, and buying it in slightly larger quantities will help reduce the cost per strip. There are packs that are

36" x 12" available online that work perfectly for making purfling strips, since the length is long enough and the width allows for many strips to be sawn from one glued up sheet. Do not select a very exotic or expensive veneer unless the coloring is desired. A piece of standard Walnut and a piece of Walnut burl used in a purfling strip will look exactly the same when viewed on edge, as it will be when installed. The less expensive the wood species choice, the lower the price of the strips will be.

The pieces will be glued together as seen in the diagram above, with the darker species sandwiching the lighter species.



Spread the glue quickly using a glue roller and sandwich the pieces between some wax paper and a couple large flat pieces of MDF. Cover the MDF all over with gym weights or clamp thoroughly with high clamping pressure. Titebond Original works well for this.



Allow the piece to dry several hours or overnight, and rip into 1/8" wide strips on the table saw. Use a thin kerf blade and a zero clearance insert to get the most yield and the least waste. They then can be bent and installed as seen in the diagram above, on the top and lower edges of the binding.

LAMINATING A NECK

Any guitar neck, whether for an acoustic or an electric can be made more eye catching by laminating it from more than one piece of wood. Not only does using several pieces of wood give a unique look, but the process of gluing them all together makes a neck that is actually stronger than a single piece of wood.

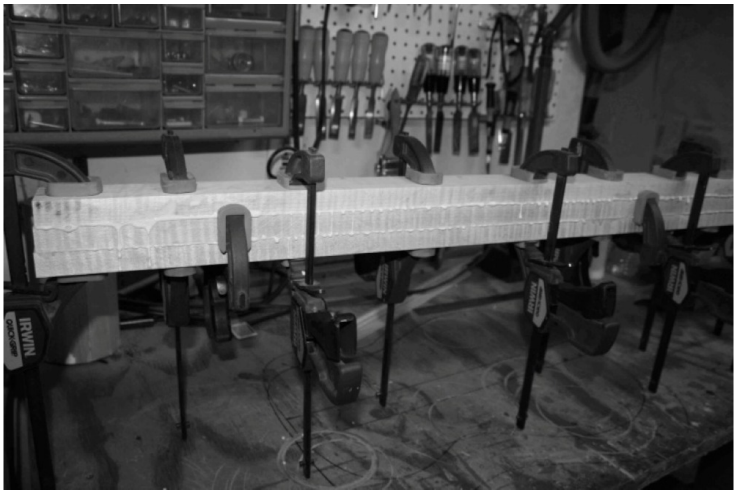
An easy method for a first neck lamination is to select a piece of figured 4/4 Maple that is flat sawn, 3.5" wide, and about 40" long. This will be enough for a single stacked acoustic guitar neck. The pieces that will be cut from this blank will be turned on their side before being glued together. This is the reason a flat sawn board is called for. When the flat sawn pieces are turned on their sides, they will be quarter sawn in relation to the string tension on the neck. This makes a stronger neck with less twisting and warping issues down the road.

It is not necessary to get a piece with high end figure to get a nice effect from this technique. A piece with low to medium figure will look great once a finish is applied, and the added fine lines between the pieces will offset the figure, drawing more attention to the neck anyway.

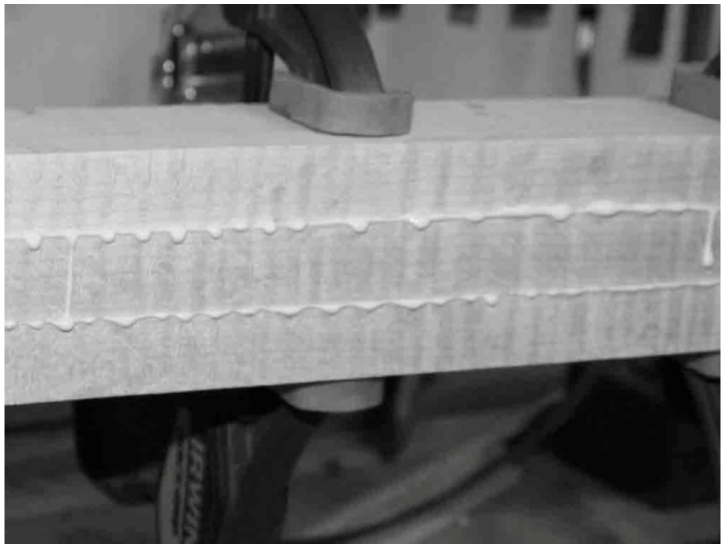
Look at the wood available and select one that has a nice looking grain pattern as well as being straight and not warped. The grain pattern in the picture shows what nice looking figure looks like. This was found in a bin of other figured pieces, and it was not any more expensive. The grain looks nice, the board is flat, and it should make an excellent looking and functioning neck.

Set a stop on the table saw at one inch and rip the board into three pieces. The thickness of a 4/4 board is about 13/16", so when the three pieces are placed next to each other, they will total 2-7/16" wide. This is perfectly sized for a neck blank, since most guitar necks are about 2-1/8" wide at their widest point.

The pieces are now stood on end, and stacked together to test the look of the blank. Notice how the figure is amplified by cutting and stacking the pieces together.



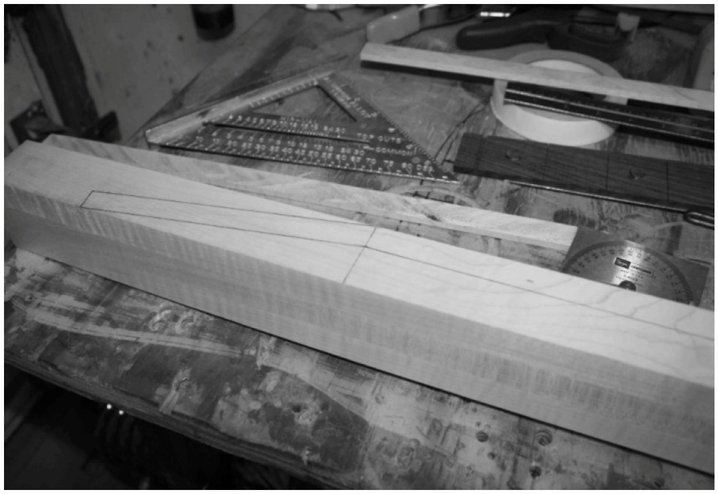
Apply glue (Titebond Original) between the layers of wood using a glue roller if available to speed up the spreading. If there is no glue roller available a finger can be used. Once there is glue between each piece, stack them together and start clamping. Place the clamps all over the piece with medium to light tension at first. This initial clamping is just to get them all in place and keep the pieces from moving around. Use a couple clamps to keep the pieces from sliding side to side as the clamps tighten the boards together. Once all the clamps are in position, start applying more pressure to each one. Work through all of them, then go back again and apply a little more pressure. Glue squeezing out is a good thing, and it indicates a solid joint without any gaps. Let this whole unit dry for 24 hours before taking off the clamps because there is a lot of glue here, and it will need extra time to dry.



After the glue has dried, remove the clamps, and using a chisel, remove as much of the dried glue as possible. Once that has been done, run the piece through the planer to flatten out the two surfaces that had glue on them. Make sure to run both sides through so the final piece is a uniform size. The final thickness of the piece will be a little less than 1" after planing.

Check the piece after it has been planed to make sure there is no tear out, or any other planer related issues with the wood. Make sure it is still straight, and that the glue joint is very thin with no gaps where the wood was not pressed together enough. Once satisfied that the neck looks good, it can be marked for gluing into a stacked neck blank. The small lines on the wood will help with aligning the pieces, and will actually help the heel of the neck to look less like a stacked heel, and more like one piece.

Remember to save the extra waste from the neck after stacking to use as ears on the peg head to widen it later on.



The blank in the pictures was from a through the body electric bass neck, which is why it is a little bit thicker than the acoustic version would be. The neck in the pictures is 2" thick, where the acoustic neck would be 1" thick. The process is still the same though, the only difference is how wide the pieces are cut initially before they are turned on their sides and glued. The wider the pieces are cut, the thicker the resulting blank will be.

Project Notes:

Making a laminated neck does require a little more effort than making a standard neck, however the results are worth the effort. There are literally endless ways to make a laminated neck, and the color and pattern possibilities are only limited by the imagination.

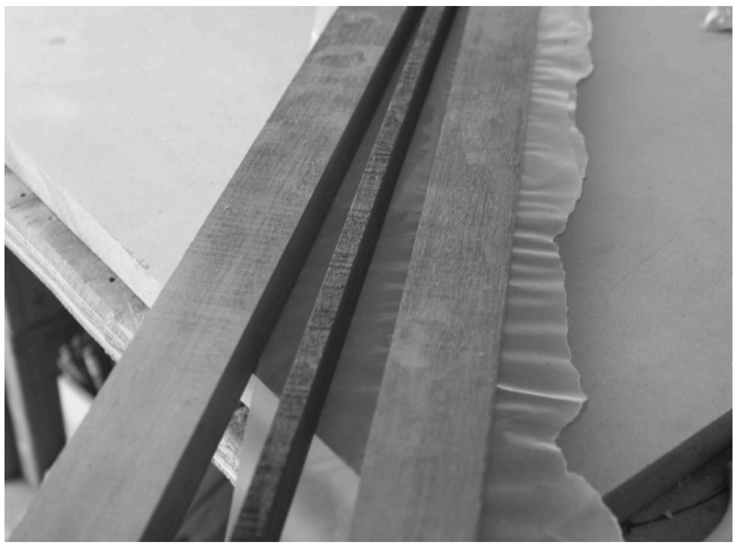
A classic look is figured Maple with a dark line running up and down the neck. This is done with walnut veneer sandwiched between the layers of Maple. It is a sharp look that seems like it takes much more than it does to pull off.

Instead of gluing the Maple to itself like in the above example, glue a piece of Walnut veneer in there first. The order from top to bottom would go Maple, Walnut, Maple, Walnut, Maple.

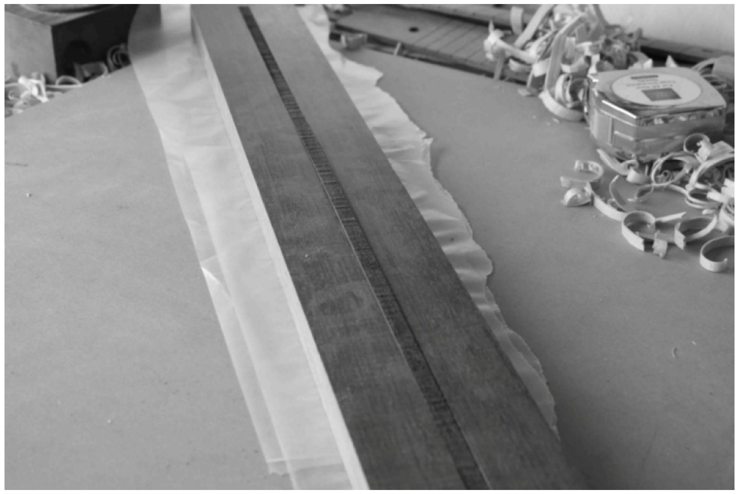
Gluing the extra veneers will add time to the total glue up, which needs to be kept to a minimum so the glue does not dry before it can be clamped well. It is definitely recommended that a glue roller be used because it will take a tenth of the time to spread the glue out versus using a couple fingers.

LAMINATED NECK NUMBER TWO

This lamination is made from two species of wood, with the darker of the two creating a strip that runs up the middle of the neck. This is a classic look that many guitar makers use.



The three pieces in the picture are all 4/4 thick, and 40" long. The width of the center strip is 1/2", and the width of the outside two pieces are each 1". When they are glued together they will result in a piece that is 4/4 x 2-1/2" x 40", which is perfect size for a stacked neck blank. To get the outside two pieces, set a stop on the table saw for 1-1/8", and rip off two pieces from a nicely quarter sawn board of Mahogany, Walnut, or in this case Goncalo Alves. Then set the saw for 5/8" and rip off a strip of a darker piece of wood, like Indian Rosewood in this example. Run the cut sides of the two outside strips through the planer at the same time, only taking off enough wood to smooth the surface after the saw blade. Do the same with the piece of Indian Rosewood but for both sides.



Test fit the pieces together and make sure there are not any gaps between the boards because they will really stand out once the neck is finished. The dry fitting can also be done with a couple clamps to be sure the fit is exact. Once this is done, apply glue to all the mating surfaces and clamp them together. Follow the same clamping method as in the previous section, only applying high pressure with the clamps once they are all in place.

After 24 hours remove the clamps, and with a chisel remove the dried glue. Run the piece through the planer on both sides, only taking off as much as required to clean the surfaces. If the surfaces were clamped evenly enough, there may not be much more than a light sanding needed.

Project Notes:

Try adding a light colored veneer or very thin piece of wood on each side of the dark Rosewood in the middle. This would create the look of an oversized purfling strip running up the back of the neck. A very interesting look for not much extra time.

STACKED NECK BLANK

One of the easier ways to cut out an acoustic guitar neck is to make a stacked neck blank from one long board. This eliminates the need to cut a scarf joint, which is a challenge for many woodworkers. A stacked blank can be made from a single piece of 4/4 wood that is at least 2-1/2" wide and 40" long, or a laminated blank of the same dimensions.

It is important to keep the pieces in order once they are cut so that the stacked blank looks as solid as possible. Keeping the wood in the same order makes it less likely to have differences in coloring that will draw attention to the stacked heel.

Starting from one side, cross cut the following pieces off the end. A 7" piece, 22" piece, 4" piece, 3" piece, and another 3" piece. Place them back in order the same way they were cut to keep them organized for gluing.

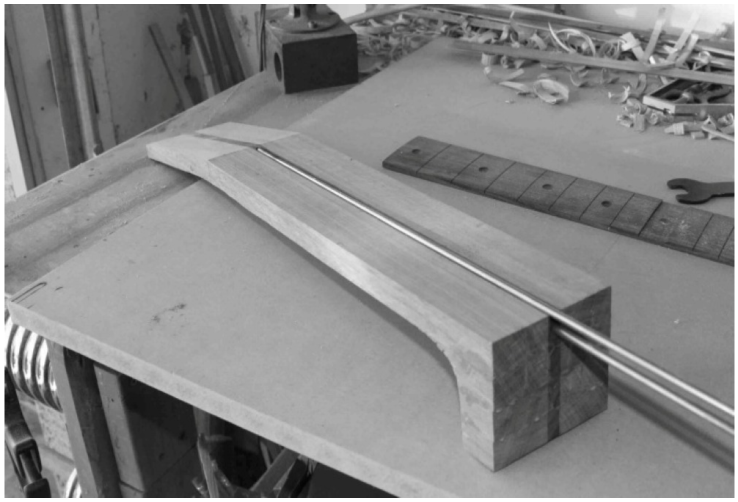
Take the 7" piece and glue it on top of the 22" piece using Titebond glue and several clamps. This will provide the extra wood needed to create the headstock angle without having to cut a scarf joint.

With the blocks laid out like the above picture, get ready to glue them all into a heel piece in the same order as they were sawn off. That means the first block to go on the 22" piece is the 4" section, then the first 3" section, followed on top by the last 3" section.

When stacked for gluing they should look like the picture, and the center stripe should line up nice and evenly though the heel. Once satisfied with the look and the lineup of the heel sections, glue them together with Titebond, and apply as many clamps as needed to lock the pieces in place.

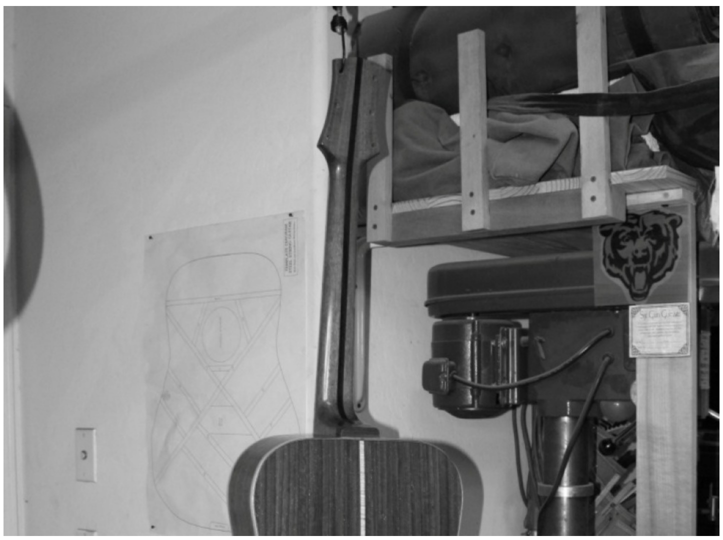
This can be a real challenge to clamp all in one shot, because there are three mating surfaces that will all be slippery with glue, and it can be hard to get them all clamped and aligned quickly enough. There is

nothing wrong with gluing the first block by itself and then going back after the glue has dried and gluing the other two blocks. It is easier, and the resulting neck will be the same.



This is the finished neck after the glue has dried, the truss rod slot routed, and the shape cut out on the band saw. After the neck is carved it will be hard to tell that it was made up of several blocks, and since the headstock was done with a stack as well there was no difficulty in cutting the shape. This blank leaves a little wiggle room for peg head size and scale length as well.

This is the same neck after being shaped and scraped smooth. The glue lines all but disappear, and the lamination of the two different woods really looks nice together. The only extra steps in making a laminated neck instead of a standard single species neck, is gluing up the pieces and flattening them. After that, the neck making process is exactly the same from stacking out the blank through carving and finishing. It looks so much nicer to have a laminated neck, and this should now be very easy to do on future guitars.



This is the finished laminated neck, on the guitar hanging to dry in the shop. The Rosewood center stripe makes the neck stand out, and it travels right into the center stripe on the back of the guitar.

The fact that it is made out of several pieces all stacked and glued together is hidden by the center stripe of wood. It draws the attention away from the stacked construction and moves it towards the nice straight lines.

Stacks also work for non-laminated necks as well, and the same rules apply while making the glue up. Use the pieces that were adjacent to each other and keep them that way in the stack. Lining up the grain and keeping the stack well squared also makes it harder to detect that it is not a solid piece.

These Mahogany neck blanks are ready to be glued up and they are not going to be laminated with a stripe down the middle. The grain pattern on the wood however is so straight and the color so consistent that it will not matter. The joints will almost disappear when the neck is finished, and it should end up being a good looking neck.

The neck below is a stacked neck, and the joints are practically invisible. Good tight clamping pressure, and nice flat pieces make for barely visible joints when making these kinds of necks.

Project Notes:

Stacking saves wood resources, saves money, and saves some of the harder parts of making a neck, like cutting a scarf joint. It is well

worth trying out at least once, and might end up being the way necks are made from here on out.

This method also allows for a larger selection of wood to be used, because a large blank, which is harder to find, is not need to make the neck.

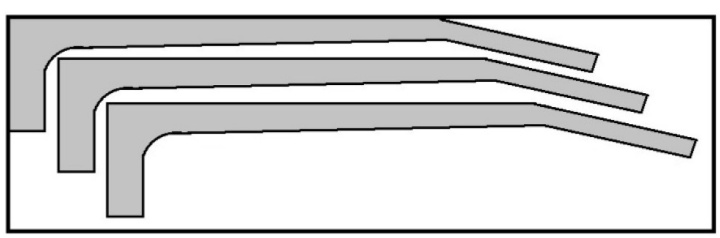
STACKED NECK BLANK NUMBER TWO

Making a neck from a single board can also be done with a wider board that is not long enough to make the stacked neck from the previous example. A single board that is around 30" long, and 8" wide can yield three pieces which can be laminated together and carved into a neck.

The best wood for this type of construction is flat sawn, because when the pieces are stacked and glued the grain pattern will rotate 90 degrees, making the grain stand vertically. This is the best way to orient guitar wood for neck making.

The first thing that is needed is a guitar neck profile, which can be made from the instructions in chapter two on template making. If making the neck for a certain set of plans and sizes being followed, use those measurements when making the template. If not, the dimensions listed in the other chapter are workable into many different full size guitar plans.

These necks will need to have the fretboard area and the headstock area planed flat before using them, so allow about 1/8" of extra wood in these places which will be planed down later.



Using the template as a guide, draw three necks on the side of a 4/4 piece of wood, nesting them so the least amount of waste is made. If a wider piece of wood is going to be used, place as many necks as possible on

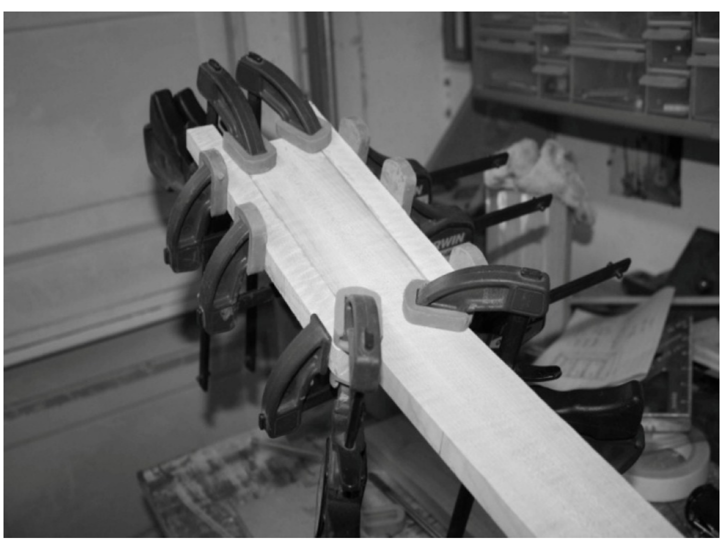
the wood, though generally speaking it may not match if pieces of wood from the same board are not used. If three pieces cannot be drawn out, and there is not another board that matches in color, grain, and figure, then do not mark more than three. The rest can be used as scrap, or for another purpose later on down the road.

Once the pieces have been laid out and marked, they can be taken over to the band saw and cut out. Try to follow just outside the lines, especially in the fretboard area and the headstock area. Gather up the three pieces and also gather some clamps and wood glue.

Clamp the three pieces together with wood glue between both joints, and make sure that there is complete glue coverage on the faces. Apply many clamps, tighten them evenly, and let the neck dry overnight or for at least several hours before handling it any further.

Remove the clamps once the piece has dried, and inspect the joint for any issues. If everything looks good, bring the neck over to the jointer and run the fretboard area through a few times, keeping the side of the neck tightly pressed against the fence to keep it square. After a couple passes, check the neck to see how the smoothing is going, and stop once the entire surface is flat.

Next, run the headstock face through the planer as well, keeping the side flat against the fence, and taking shallow cuts. Once this area is flat, stop planing and inspect the newly created surfaces. The glue lines should be clean, free from gaps, and the faces completely flat after the jointer.



The rest of the carving can take place like normal, from fitting the end with a dovetail, mortise and tenon, or dowel joint, to rounding out the back of the neck for playing. This will function in much the same way as the laminated curly Maple neck from earlier in the chapter, though the construction method is slightly different.

Attach wings to the headstock to broaden it for shaping, which can be glued on and clamped like in the picture above. A helpful tip when attaching wings is to flatten the front facing side of the pieces, and line them up perfectly flat with the peg face. The back side will stick out a little bit, but the peg face will be totally flat. This means that only the rear will need very aggressive sanding and scraping, and the front will only need a basic sanding.

STANDARD BLANK SIZES

When making blanks from standard sized lumber, it is nice to have a list of sizes needed for each part of the guitar. This can be carried in the wallet on a small piece of paper or index card, and will always be there in case it is ever needed. Knowing the sizes required to make each part of the guitar makes it easy to select pieces of wood that can be cut down to make specific blanks.

The dimensions given here have a small margin added to them, in order to ensure that an adequate piece can be made from the blank sizes listed. As long as a piece of wood is at least the dimensions shown, it will be able to be made into that part of the guitar.

Bridge blanks are 6" x 1-1/2" x 3/8" for a standard shaped acoustic guitar bridge as seen in the picture above. Several of these can be cut from one piece of 4/4 Indian Rosewood, following the diagrams earlier in the chapter. The grain should run from end to end as seen in the picture above.

Peg head veneer needs to be a little larger than the size of the headstock being made, and a 4" x 8" piece should work nicely in most cases. In the event of a really large or oddly shaped headstock, the veneer size will also need to change. This size will work however for the majority of acoustic guitars. The thickness should be no more than 1/8", otherwise the headstock itself will need to be made thinner when it is cut from the neck blank.

The internal bracing is a very passionate subject for many guitar makers, and everyone who has made guitars for a while will have their own special formula for the inside. There is however a standard blank size that many bracing patterns can be cut from, which takes into account the longest brace that will need to be made.

The X-braces are the longest braces in the guitar, and for most acoustics they are 20" long or a little less. A Sitka Spruce blank that is 4/4 thick, at least 20" long, and a few inches wide can be cut into any width of bracing to match any specific bracing design. Make sure the piece is quarter sawn, and just for reference most of the braces in my guitars are 5/16" wide or less.

When making a stacked neck, the blank will need to be 40" long, 2-1/2" wide, 4/4 thick, and as straight as possible. The piece should be quarter sawn, and have fairly straight grain running from end to end. A piece with very warped grain can twist over time, and cause severe problems with the neck. The neck is probably the most important piece to check the grain for straightness and pass on any pieces that have too much angle to them.

Fretboards can be made from blanks that are 19" long, 2-1/2" wide, and 1/4" thick. The best thing to do is to take a piece that is 4/4 and split it open down the middle, making two pieces that are the same dimensions but half as thick. These two pieces can then each be made into a fretboard without wasting wood by planing through so much material.

The sides can vary depending on the type of guitar being made and the thickness of the body at the lower bout. Most guitars will be fine with a blank that is 5-1/2" wide, 35" long, and 4/4 thick. These dimensions will work for most Dreadnought, Orchestra Model, and standard shaped guitars with a 16" lower bout. A jumbo guitar, or a guitar with a lower bout

that will be larger than 16" will need to have longer pieces for the sides. The 4/4 piece can be split open on the table saw and planed to make two book matched sides from the same board.

The back of a guitar of almost any shape that has a lower bout of 16" can be cut from a blank that is 8-1/2" wide by 21" long and 4/4 thick. This will allow the piece to be split open down the middle and planed flat for a book matched set.

Making the blanks for the guitar instead of buying them saves money, and means that more of the guitar will be handmade. Follow the techniques from earlier in the chapter and any piece of wood found in the hardwood store can be made into a guitar.

Project Notes:

At a glance, here are the blank sizes to refer to when shopping for wood. Carry theses dimensions in the wallet written on a piece of paper in case they are needed. This way, a fantastic piece of wood will not be left behind because the needed dimensions were not know.

Bridge: 6" x 1-1/2" x 3/8"
(Split several from a 4/4 piece)

Peg Head Veneer: 4" x 8" x 1/8"

(Split several from a 4/4 piece)

Internal Braces: 20" x 3" x 4/4
(Blanks are usually sold around 2-1/2" wide)

Fretboards: 19" x 2-1/2" x 1/4"
(Split two of these from a 4/4 piece)

Sides: 35" x 5-1/2" x 1/8"
(Split two of these from a 4/4 piece)

Back Plate: 8-1/2" x 21" x 1/8"
(Split two of these from a 4/4 piece)

CHAPTER TWO

SHOP MADE TOOLS AND JIGS

Many of the tools that guitar makers use can be made in the shop from scrap wood. These tools and jigs have little to no cost, because they are made from odds and ends, and left over pieces of wood.

A guitar maker could go broke buying all the different tools that are available online from the suppliers. If there is a problem, no matter how minor, there is a tool being sold for it. Some tools are really good to have and cannot be made in the shop, however some tools only look like they were invented to be sold to someone who does not know any better.

The fact of the matter is that if a person can make a guitar, they can also make many of the jigs required along the way, and most of their own tools as well. Making a fret bending jig is a walk in the park when compared to making an acoustic guitar. A good attempt should be made at making as many tools and jigs as possible before buying any of them.

The largest single expense for instrument makers and wood workers is the tools required to complete the projects. This expense can be reduced a little bit by only buying necessary tools and learning how to use existing tools to do more. However, there will be a certain number of things that will have to either be purchased or made, in order to enjoy the craft of instrument making.

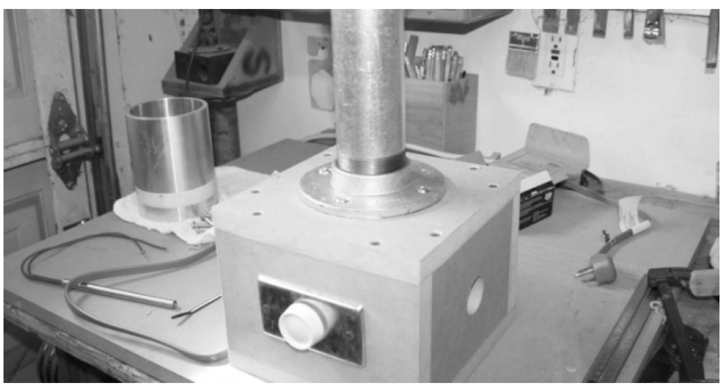
Clamps are one example, and they can be one of the most expensive sets of items in the entire work shop. It will require at least twenty specialized clamps to glue down the braces to the top, and another sixty or more smaller clamps to glue the kerfed linings to the sides. Plus, there will be clamps needed for other operations like gluing the plates to the sides and gluing the bridge to the soundboard. If all the clamps for guitar making were made instead of bought, it would pay for this book more than ten times. Thankfully, there are instructions for four different styles of guitar making clamps inside.

The specialized tools that are unique to guitar making are the next largest expense, and this is because they cannot be used for anything else. There are a hundred different places that will sell a band saw, which creates competition and keeps the prices in a reasonable range. A fretboard slotting jig however, can only really be used by one type of woodworker, and is only sold by a few places. The product is a specialty item, and there is a higher price to pay to own it.

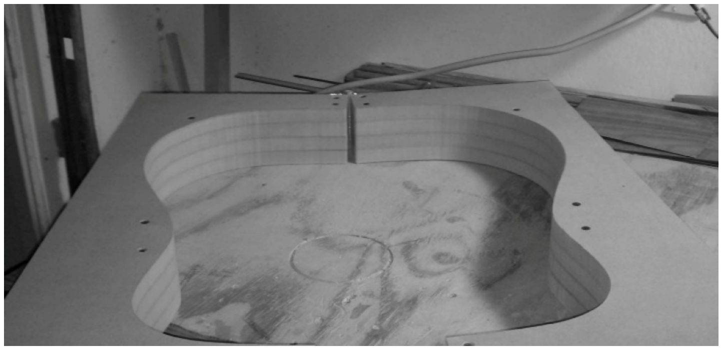
Unfortunately, many guitar making items are going to be expensive to buy, but the good news is that they are also all fairly easy to build. Anyone who has a few simple shop tools can make many popular tools instead of buying them, which will save even more money in the long run.

If all the tools in this chapter are made instead of bought, it will save the guitar maker thousands of dollars. The tools will function just the same, and great looking guitars will result from their use.

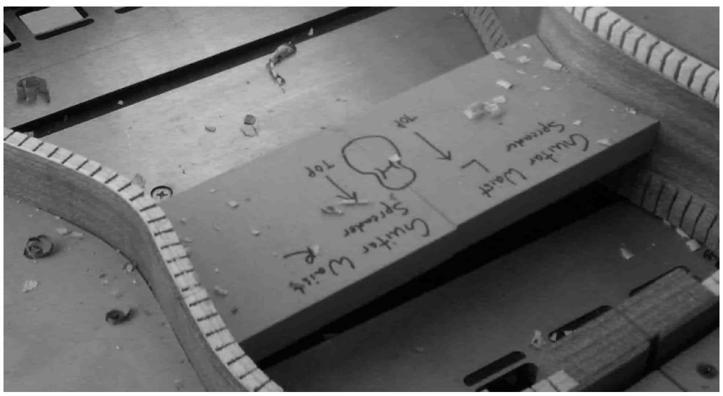
In this Section We Will Cover:



Making an electric bending iron with a variable temperature control. See here.



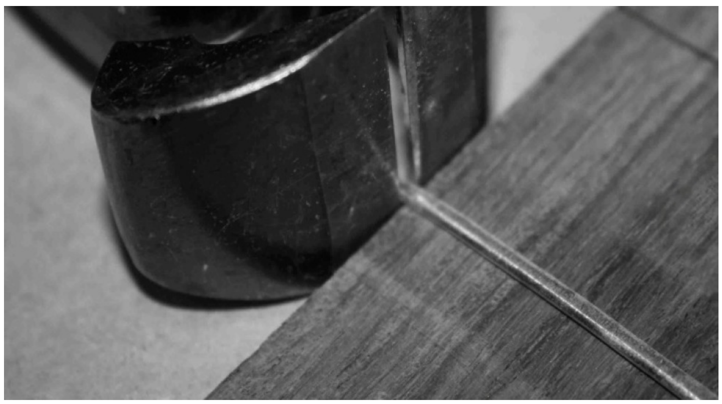
Making an outside mold to aid in making evenly shaped bodies. See here.



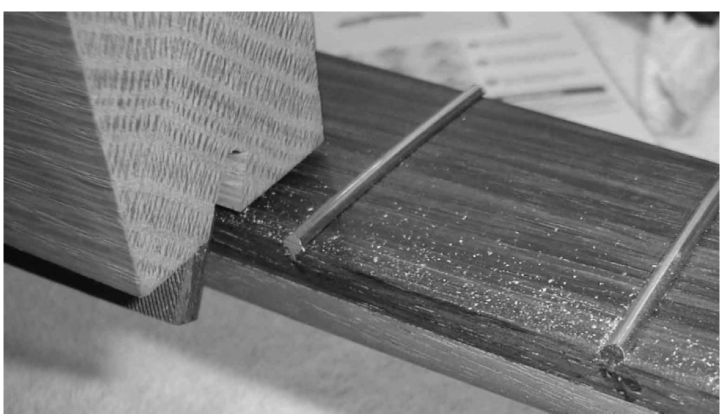
Guitar mold spreaders to help keep the sides in place while gluing. See here.

How to construct a fret bending jig for bending fret wire to a perfect radius. See here.

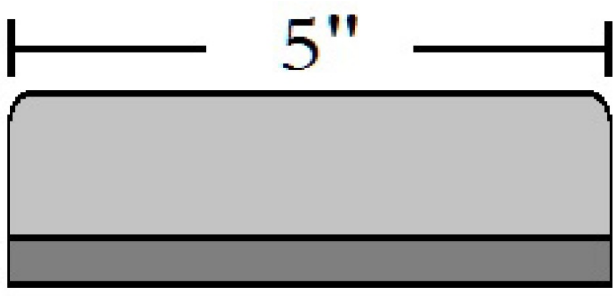
The fret setting caul, and how this easy to make piece will improve fretting. See here.



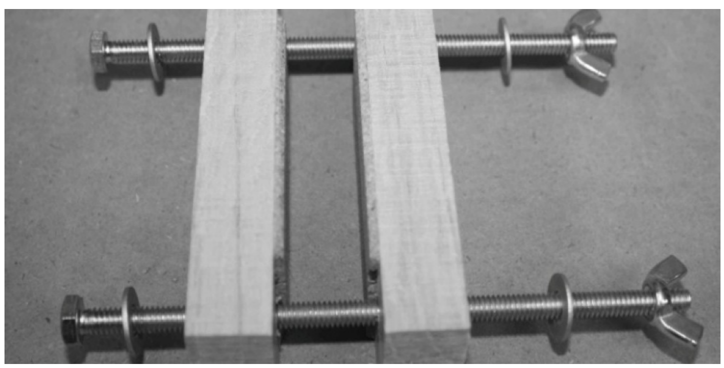
Custom grinding a pair of fret nipper pliers from an old set of cutters. See here.



A fret beveling file for evenly chamfering the fret ends on the neck. See here.



A hand held fret leveling file for leveling a large area at once. See here.



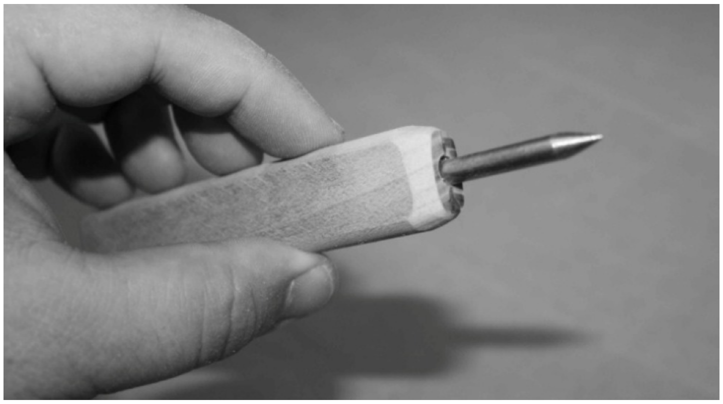
Fretboard gluing clamps and how to make them from shop scraps. See here.

Shop made sanding sticks for getting into hard to reach places. See here.

An easy sanding block that is very useful when final sanding the guitar. See here.

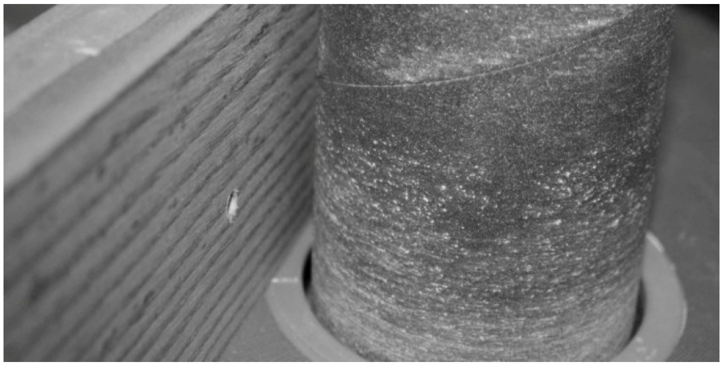
A more refined heirloom sanding block that uses a one third sheet of sandpaper. See here.

Shop made clearance notch saws for sawing the string notches in the guitar bridge. See here.

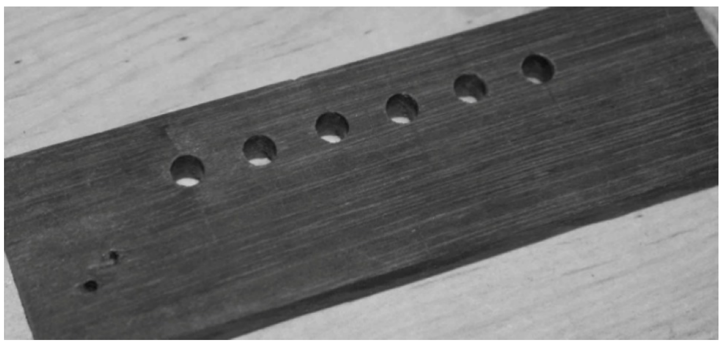


A scratch awl for marking as well as making a depression for easier drilling. See here.

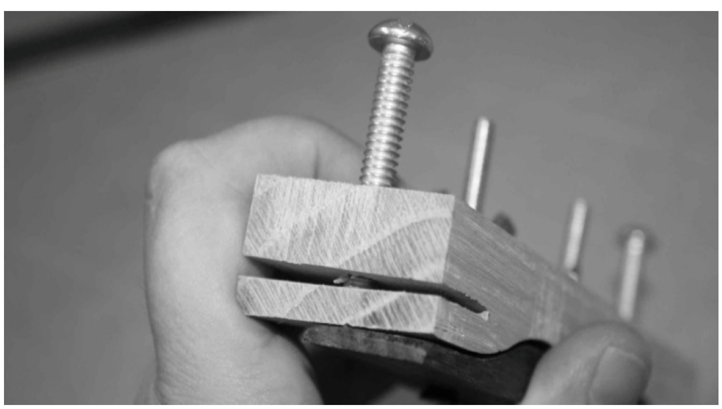
A riser for the thickness planer, and how one of these will make the planer work better. See here.



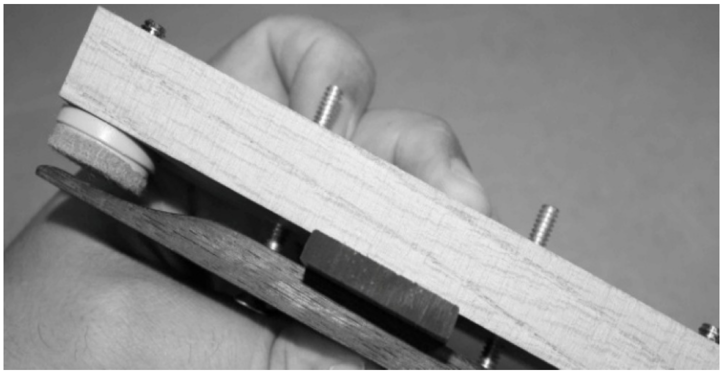
Turning a spindle sander into a thickness sander with a simple add on fence. See here.



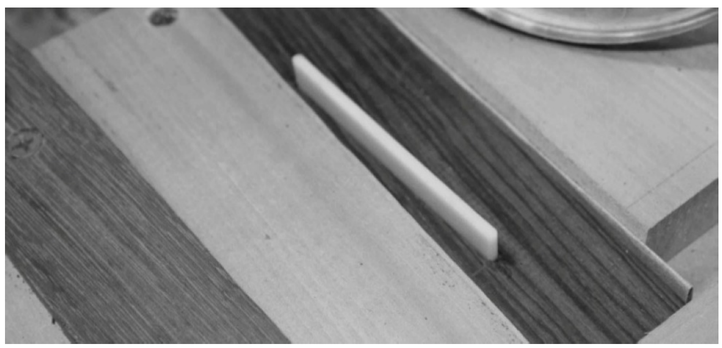
Making and using a bridge pin drilling guide for more accurate bridge pins. See here.



How to make a bridge clamping caul for attaching the bridge to the top. See here.

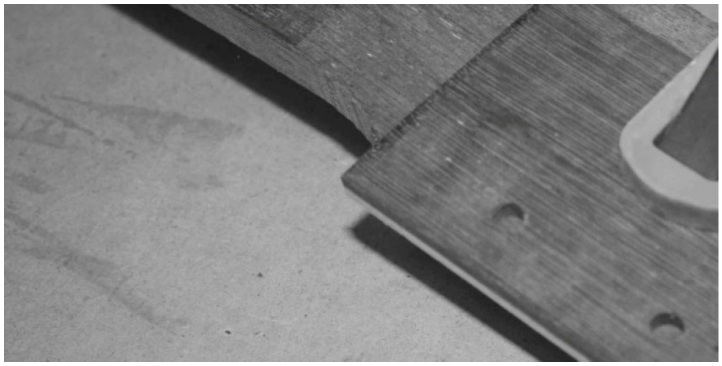


Another bridge clamping caul that is a little more universal in design. See here.



A saddle slotting jig that makes routing on the bridge very easy and accurate. See here.

Making a stand for the buffing machine with storage for extra wheels. See here.

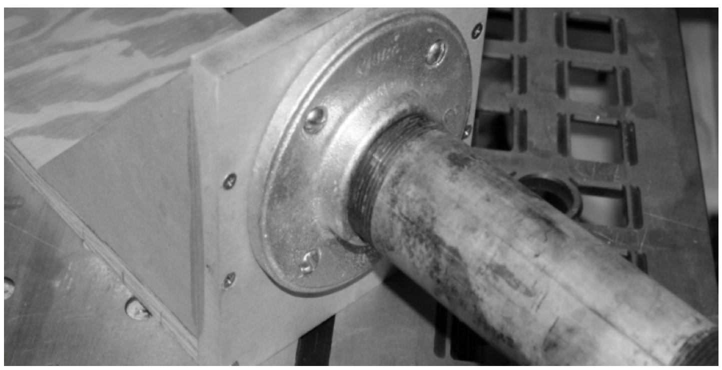


A guide for drilling peg head holes, making the location of the tuners more accurate. See here.

The flat work board, and how having one of these helps in many ways. See here.

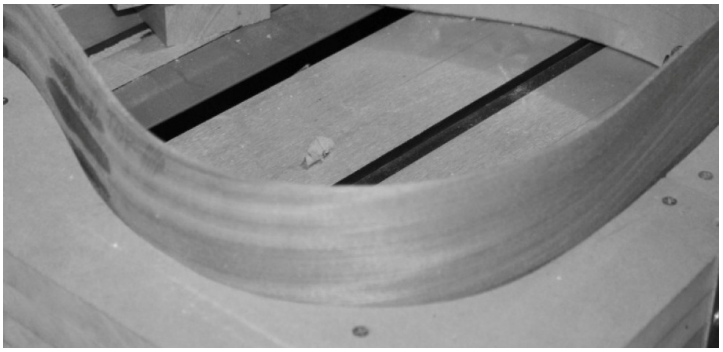
Constructing a book matching press that joins tops and backs using the work board. See here.

Making and using a carpeted work board to protect the instrument. See here.

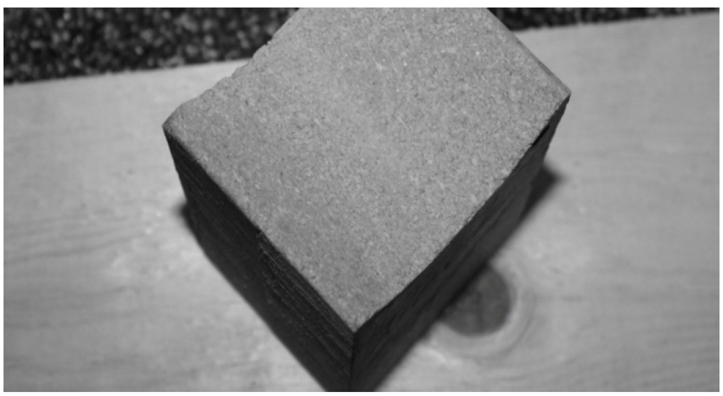


Making a propane side bending setup, and how to use it to bend wood. See here.

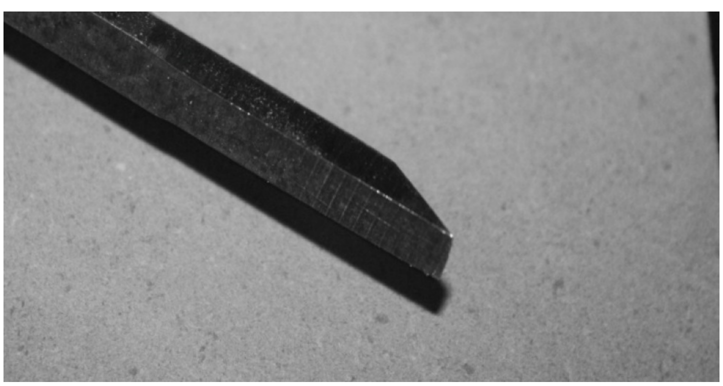
An alternative version of the propane side bender, with multiple radii. See here.



Using a bending strap, and how to easily make one from a piece of sheet metal. See here.



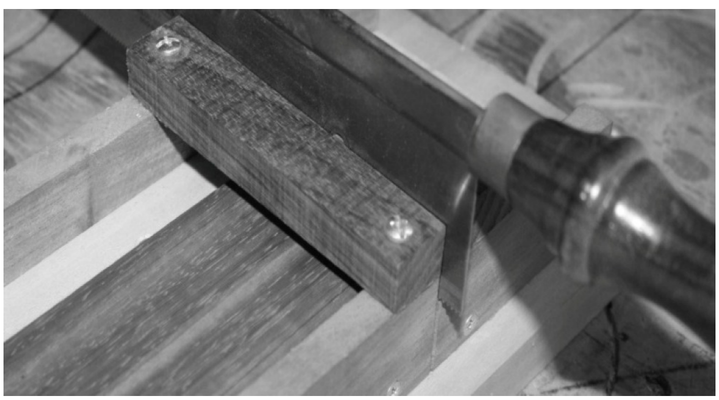
Making a neck support caul, for an extra hand while working on the guitar. See here.



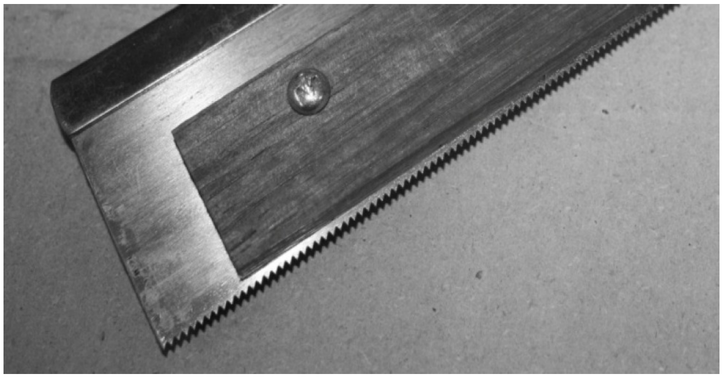
How to custom grind the profile on a chisel for better cutting and precise size. See here.

How to make a table saw fence addition, and use it for re-sawing large pieces of wood. See here.

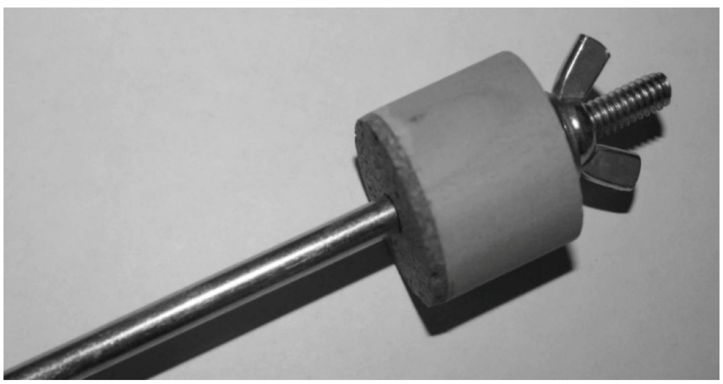
How to turn ordinary clothespins into strong kerfing clamps and how to use them. See here.



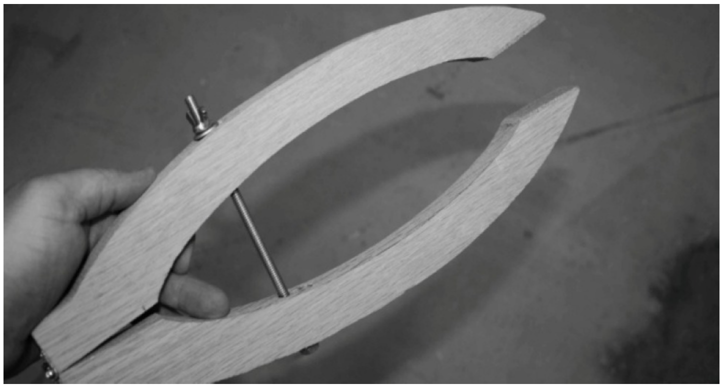
How to make a fretboard slotting jig that will duplicate any existing fretboard perfectly. See here.



Making an easy and accurate fret saw depth stop, to ensure accurate fretting. See here.

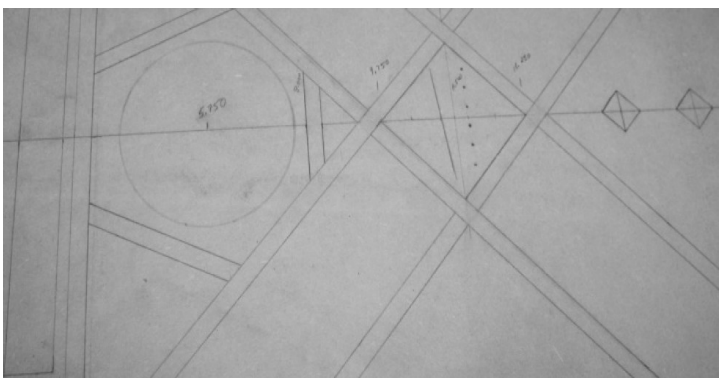


Making several spool clamps that are useful in many clamping operations. See here.



Lapstrake clamps, and how these boat making clamps are also great guitar making clamps. See here.

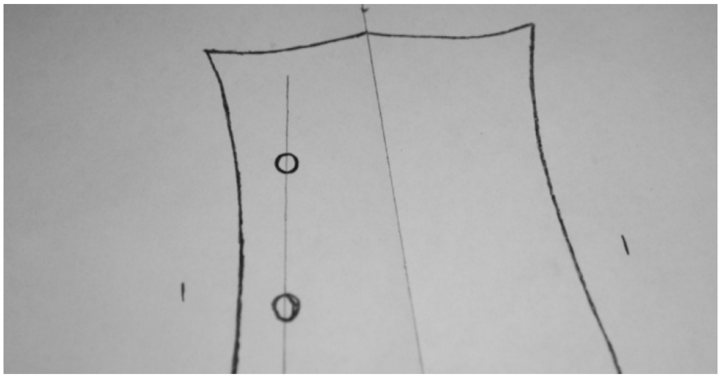
How to make dozens of cam clamps to use in the shop for very little cost. See here.



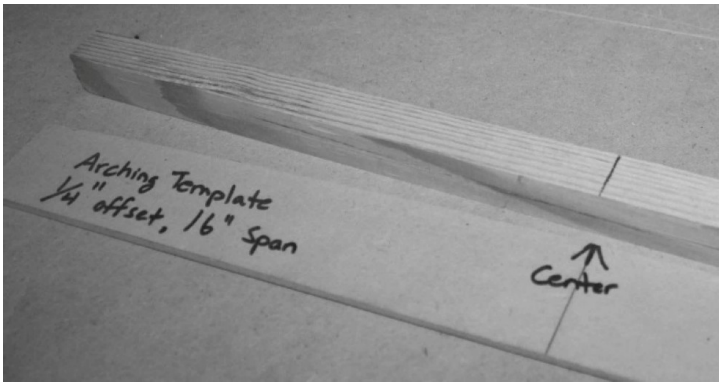
Guitar soundboard bracing templates, and why they are useful. See here.

How to make a bridge blank template for tracing out custom bridge shapes. See here.

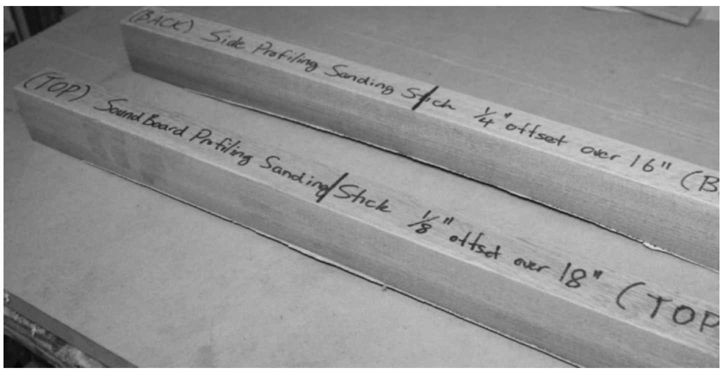
How to make a neck profile template to make cutting out the neck quick and easy. See here.



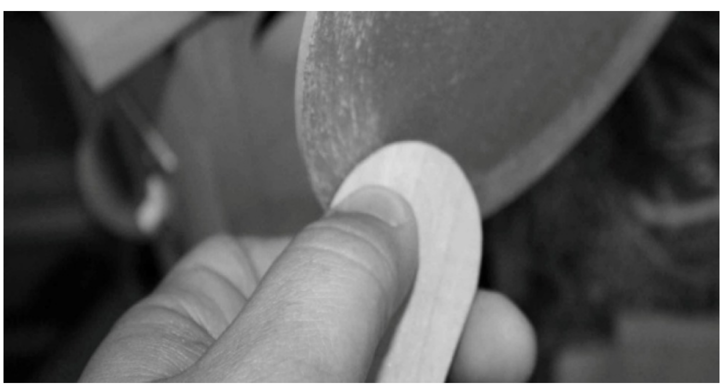
A tracing technique for making mirror image custom headstock shapes. See here.



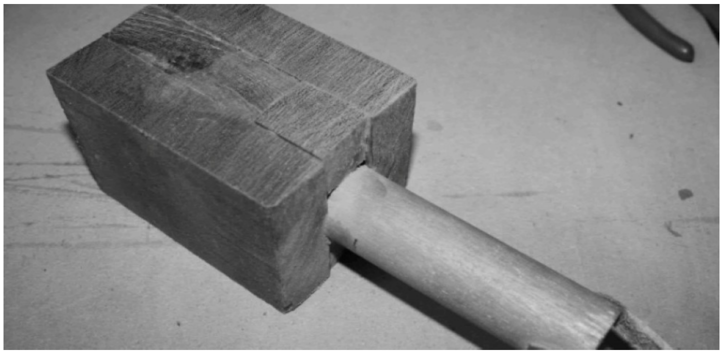
Creating a set of templates for evenly arching the braces on the soundboard and back. See here.



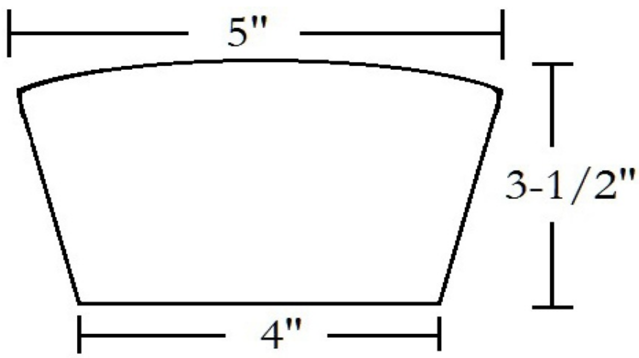
Making a set of sanding sticks that will easily bevel the sides to accept the arched plates. See here.



How to make a custom sanding disc for the buffing arbor to help shape bridges. See here.



An easy mallet that can be used to aid in carving the top and back braces. See here.



A second mallet that uses a different construction method. See here.

An easy jig for making kerfing strips on the band saw. See here.

A less expensive but equally effective hide glue pot. See here.

Project Notes:

Before any tool or jig is purchased, it is well worth the time and effort to try doing a little research and seeing if there is an easy method of making it first. Do a little research into the construction of the jig, and ask around to see what other guitar makers are doing about the same problem. Once a good idea of how to make the tool is formed, begin the process on paper.

The best pace to plan a large project like a jig or a tool is to draw out every possible detail on paper first. This way, problems in construction can be avoided, and unforeseen problems will hopefully show themselves. Take the time to plan out the exact dimensions, the type of wood to be used, and the hardware that will be needed. This way, an accurate representation of the tool can be created on paper.

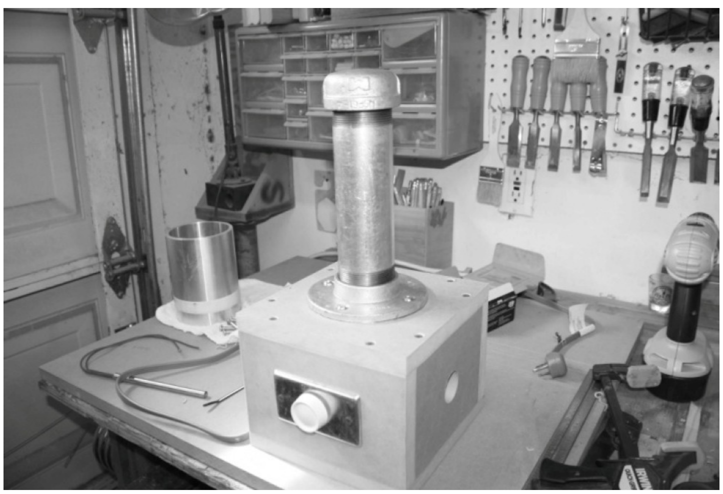
Once the tool has been worked out on paper, begin making the piece. Stick to the plans as written so that no further mistakes are made, and only change something if it is completely necessary to the build. It makes no sense to go through the effort of planning out a project and then not following the plans.

When the tool is made, give it a thorough once over to check that it is of sound construction, and that there are no loose parts. Especially if it will be used with a power tool like a table saw, it is best to be sure it is safe long before adding another element of danger. After the piece has made it through a thorough check, it will be ready to start testing.

Test out the jig or tool using inexpensive wood like pine, and use the item for a while. If after many uses the tool works well, then it can be finished if needed, and used to help make guitar building easier.

ELECTRIC BENDING IRON

Of all the best tools for guitar making, an electric bending iron is right up there at the top of the list. The reason for this is the fact that a reliable, controllable, and consistent method of regulating bending temperature means more successfully bent sides and less broken and wasted wood. These tools sell for more than some power tools in many cases, and the really cheap units have a long list of short comings. Having a quality iron will make a difference in the shop, making this project well worth the time it takes to make it.



The unit that will be described here is a 110v, 500 watt side bending iron, with pipe that has a 6" smooth area for bending. This size will be large enough for even the widest of side pieces, and the 2" diameter is also big enough for the larger curves on the lower bout.

In places other than the United States, there are options for purchasing a cartridge heater in a different voltage, which can easily be adapted to function in other outlet styles. The only difference in construction will be which cartridge heater is placed in the unit, the rheostat, and the style of plug attached. Being that this unit was built for use in America, the directions here will all be for 110v.

A housing made from MDF will be the support for the pipe, as well as housing the controls which consist of a rheostat with an on/off switch built in. Rheostat is a fancy word for dimmer switch, and they work on heating elements as well as lights.

Since some people like to use a bending iron in the upright position, and some prefer the unit to be laid horizontally. The base can accommodate both, and is easily clamped to the bench either way. The holes in the sides are meant for clamping holds as well as for ventilation of the heat that will seep through the bottom of the pipe during use.

A laundry list of supplies will be required to make the electric bender, though many of these may already be in the shop. The main item that makes everything work is called a cartridge heater, and these will typically have to be purchased online.

A cartridge heater can be seen in the lower left corner of the picture above, and looks like a metal rod with a pair of insulated wires coming out of the back end. These are sold in several different voltage and wattage configurations, and are fairly inexpensive if bought from overseas. Most of the store bought units run on a 200 watt element, and that is the minimum wattage that should be purchased for this project.

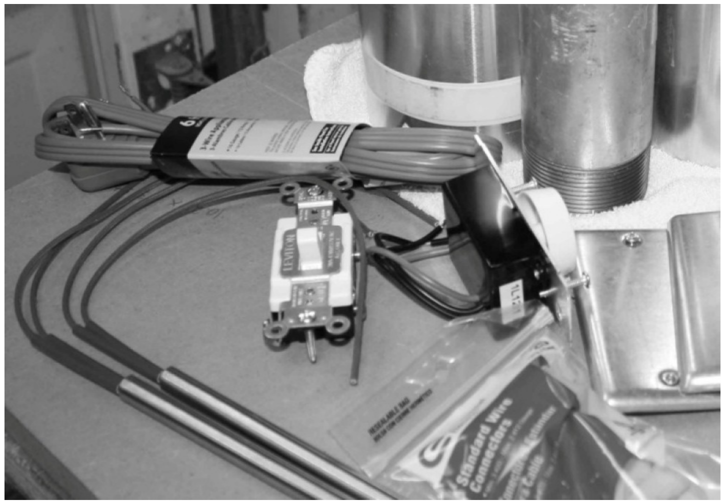
The model in the picture is a 110v 500 watt element, which was purchased because it will only need to be ran at 1/2 power to generate the heat required to bend wood. The rheostat can reduce the total output to 10% at the minimum, so it can be ran through a very large range depending on what temperature is needed. Also, running the unit at a lower than

maximum heat will lengthen the life of the element by not asking it to run at full power constantly.

Good places to look for cartridge heaters are in stores like Grainger, which depending on whether there is a location in town, the piece may be right there waiting to be bought. Less expensive units can be found online through Amazon, and will ship from China directly. This will take a few weeks, and it is a good idea to order a couple of them just in case one does not work or gets damaged while making the bender.

Finally, the size of the cartridge heater is important as well, and should be 6" long, which matches the length of the pipe being used on the iron itself. The diameter is not as important, though a larger unit will make filling the pipe easier once that step is reached. The units in the picture are 1/2" in diameter, though a larger diameter will work just as well. Again, buy two of them if ordering from overseas just in case.

The bending iron will be made from a piece of 2" diameter steel pipe that is 8" long and threaded on both ends. They are sold like this in the plumbing section of most hardware stores, or one can be cut and threaded on site in some cases. A 2" pipe cap will also be needed, as well as a metal base flange. These three pieces will be assembled to make the body of the iron, in which the heating element will reside.



The cartridge heater will work the best if it is touching metal on all sides while operating, so a method of filling the pipe is needed. A roll of aluminum flashing, which is sold in the roofing section typically, can be used for this purpose. One roll that is 6" wide and 25' long will be needed, and will fill the pipe nicely.

For the electronic controls, a rheostat with an on/off switch built in, and an appliance replacement power cord are also needed. Since this will be a higher wattage appliance, purchase a well made and heavier gauge power cord, which is designed to be a replacement for a household appliance. It will have two conductors and a ground, all three of which will be wired appropriately later on. The rheostat, or dimmer switch can be found in electrical, and only needs to be rated for at least the same wattage as the cartridge heater. These are fairly inexpensive, and a more costly unit does not mean that it will necessarily be any better than the cheap one. As long as the wattage listing is correct based on the cartridge heater, the unit is fine. While there, purchase a cover plate for the rheostat that is made from metal since it will be screwed to the housing and plastic covers may crack.

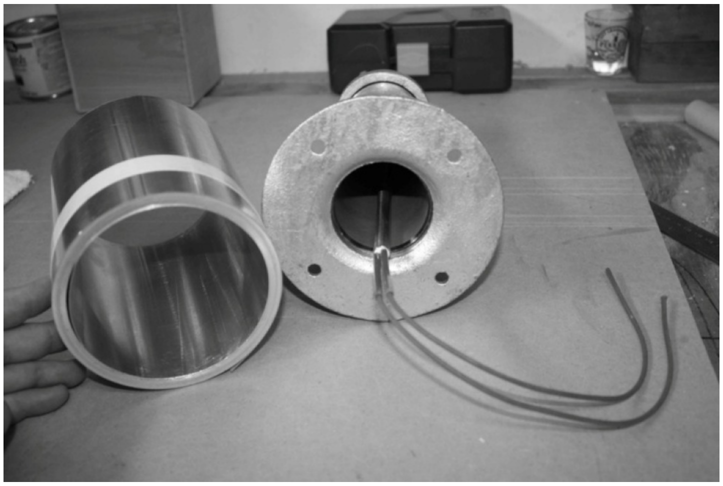
The base itself will be made from 3/4" thick MDF, which is heat and fire resistant, as well as heavy duty enough to support the forces involved in bending wood. A piece that is 2' x 2' will provide enough material with some pieces left over for scrap.

As far as odds and ends go, the following items that are not already in the shop will need to be picked up. Wire nuts to make the wiring connections under the unit, JB Weld, 1-1/2" coarse threaded wood screws (buy a box, they can always be used for something), four 1/4-20 screws that

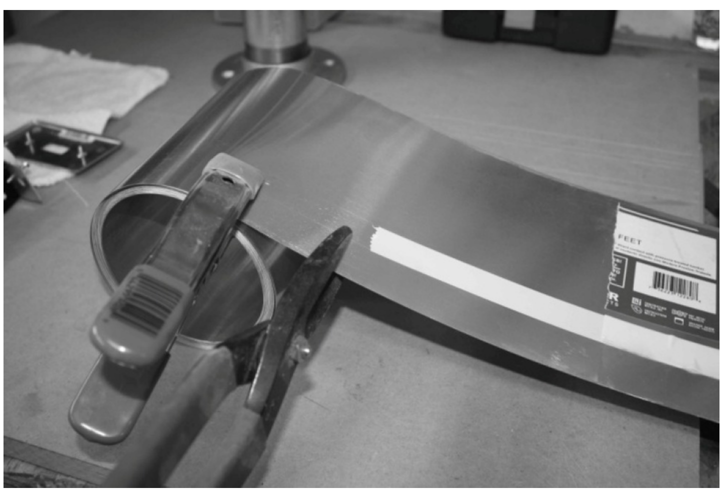
are 2" long and nuts, and a 3/4" dowel rod which will be used to roll the flashing into a tight coil.

Other than the above mentioned items, the regular list of shop tools will be used. Items like the drill press or hand drill, table saw or band saw, drill bits, rulers, pencils, and other little things that are probably already in the shop.

The first step is to use a rag and wipe down all the metal pieces with a little naphtha or another solvent to remove all the grease. Also, if there is a large piece of tape that held the price tag in place, remove all the tape and residue as well. The pipe needs to be completely free from any contaminants before using it to bend wood, otherwise these things will be transferred to the wood, causing stains that in many cases cannot be removed. Once the pieces are wiped down, test fit the flange and cap to make sure they can be screwed on and off easily, and they do not bind up. Do not screw them so tightly that they cannot be removed as this is only a test to see that the pieces were manufactured correctly and fit well.



If the cartridge heater were placed in the pipe as seen in the picture above, it would have very little effect. This is because there is so much air space between the unit and the walls of the pipe. The bottom may get very hot, but the top will not. Also, cartridge heaters require contact around their edges to transfer the heat away from the unit and prevent overheating. In order to decrease the open space, aluminum flashing will be used.

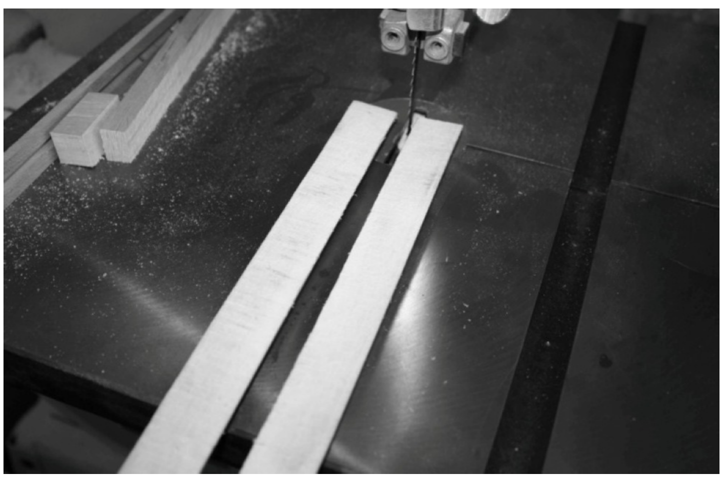


Carefully open the roll of flashing by cutting the tape and the stickers that keep it coiled together. Using a tin snips, cut through the aluminum after the stickers and tape, removing them from the roll. A clamp can be used to hold the flashing and keep it from coming uncoiled, which is

important for the next few steps. Also, cut off about 5' from the end of the roll, which will help it fit inside the end of the pipe better when coiled.

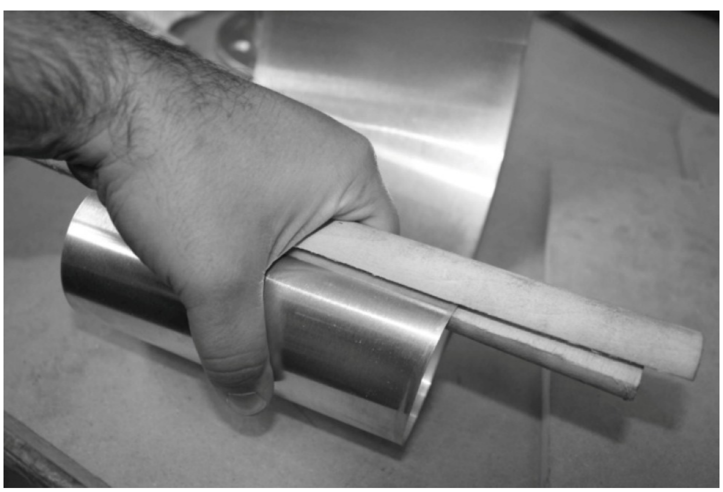
Working with metal flashing is dangerous, and safety precautions should not be overlooked. The coil of flashing is like a giant spring that is tensioned and ready to expand rapidly. When this happens unexpectedly, the razor thin edges can slice through skin quickly, requiring stitches in many cases. It is absolutely important to prepare for the next few steps by wearing some safety gear.

The coil of aluminum will need to be wound very tightly and compactly in order to be inserted into the metal pipe. This will reduce the interior diameter and leave a small space for the heating element. In doing so, the coil will have a large amount of potential energy waiting to spring loose in a catastrophic fashion. It is mandatory that long sleeves, thick gloves, a heavy shop apron, and a face shield are worn while handling and coiling the flashing. Failure to do so can result in serious injury to the hands, arms or face.



For a little extra leverage when coiling the flashing, use an 18" long piece of 3/4" dowel rod, that is split down the middle on the band saw. This will allow the flashing to be sandwiched between the pieces while the aluminum is cranked into a very tight coil.

Unroll a few feet of flashing and replace the clamp that keeps it from uncoiling. Place the end of the flashing between the dowel halves, and hold them together. The ends of the dowel can be taped together to help the rolling process, though they will turn just fine without it. Fold over the flashing right where it meets the edge of the dowel, making a L shaped bend in the metal. This will prevent the end from coming loose while the flashing is being rolled.



Begin rolling the flashing around the dowel rod as tightly as possible. Do not worry if some expansion happens from time to time during the rolling, as it will need to be further coiled later in the process anyway. The goal of this first coiling is to get the flashing down to at least half the

diameter that it was when bought in the store. At that point it can be clamped in a vise and worked on from there.

As more and more flashing is taken up, remove the clamp and allow more to uncoil. Let out a few feet at a time, making sure not to let it come out too rapidly.

Any time there is fatigue in the forearms, place the coil and the dowel in a front vise to keep it from coming unrolled again. Breaks will need to be taken fairly often throughout this process, and it will not be easily done the first time unless the hands and forearms are very strong. Clamp the piece in the vise after every few feet are rolled, conserving energy for the final coiling that is coming up.

The point of all this rolling is to reduce the outside diameter of the coil so that it can fit inside the pipe. Once inside, the metal will expand, filling up all the available space, and creating a larger contact area for the cartridge heater.

Once the coil has been fully rolled around the dowel, clamp it in the front vise and take a break that is well earned. Those who are only reading this will not truly understand how difficult this is, but those who are taking that break right now will.

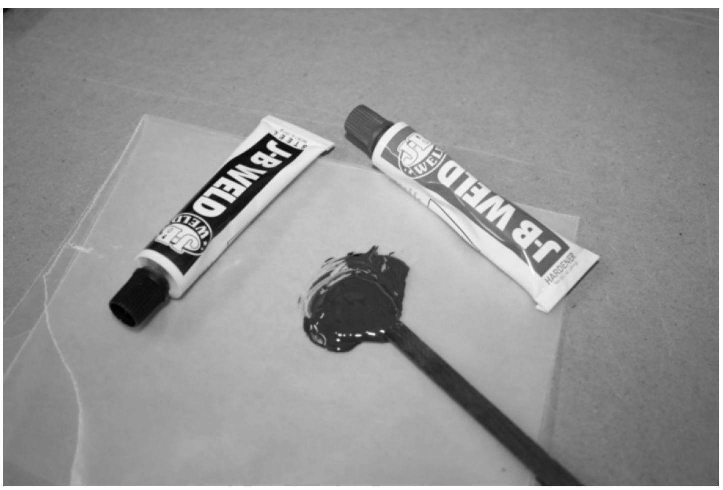
The piece can now be worked completely inside the vise, which will make holding it and coiling the aluminum a shade easier. While locked in the vise, start cranking the dowel again, tightening the coil of aluminum. When the break starts to get close to the edge, tighten the vise a little bit to prevent the coil from coming loose and flapping around. Repeat this process until the aluminum is wound tightly around the dowel, and cannot be cranked any farther. When this has been accomplished, tighten the vise to prevent the spool from coming loose.

Pick up the pipe and place it over the end of the coil, easing it inside. The dowel may need to be removed while in the vise or the top portion cut off in order to get the pipe over the flashing without having to remove it from the vise. Do not remove the flashing from the vise before trying to get it inside the pipe because it will unroll just enough to be too large a diameter to fit. Once the pipe is over the top at least half way, the vise can be opened up which will cause the flashing to expand to fit the pipe. At this point the flashing in the center will have loosened enough to remove the dowel. Remove it, and discard it because it will not be needed anymore.

Press the flashing the rest of the way into the pipe, and then lightly tap the end of the pipe on the bench or the floor a few times. This will even out the flashing inside the pipe so that the ends are pretty close to flat. Once this happens, the piece can be pushed into the pipe further, where it will be JB welded into place.

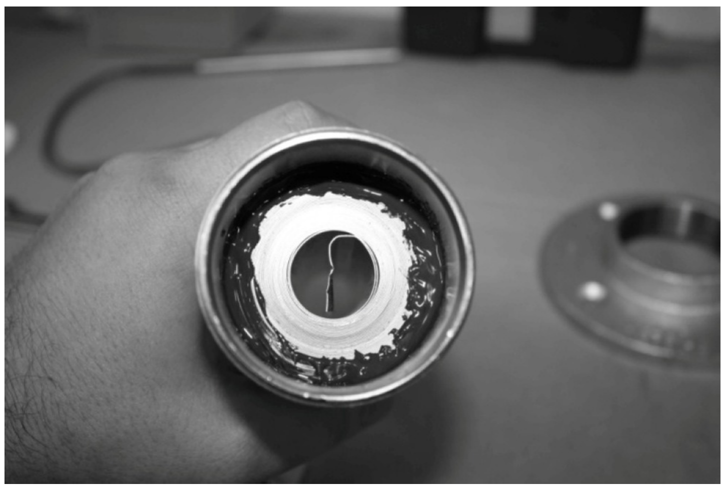
The coil will need to be pushed down into the pipe so that the whole mass resides under the smooth part of the pipe. Press from either end, using a piece of wood to keep the flashing even as well as move it down the pipe. The flashing will only need to be pushed past the threads, and then evened out with the piece of wood for the edges to be straight.

If the edges are not totally even, this is not a huge issue. The important thing is that the 6" of coil resides under the 6" of flat area of the pipe for bending, which will be powered by a 6" long cartridge heater. Having the full length of the heater as well as the flashing under the flat part of the pipe will help distribute the heat right where it needs to be.



JB Weld is an automotive and farming product that is used for making cold welds. Many times, JB weld is used to repair a cracked engine block on a piece of farming equipment, making the unit run like new. It has a working temperature of up to 600 degrees before the bond begins to break down, and is essentially the strongest epoxy on the planet. Since the average working temperature of the electric bending iron will be between 300 and 400 degrees, the product will hold up without any problems.

Mix up equal parts of the steel and hardener on a piece of folded up wax paper. Use a piece of thin wood to do the mixing, and both the wood and the wax paper can be thrown away after the JB weld has been used.

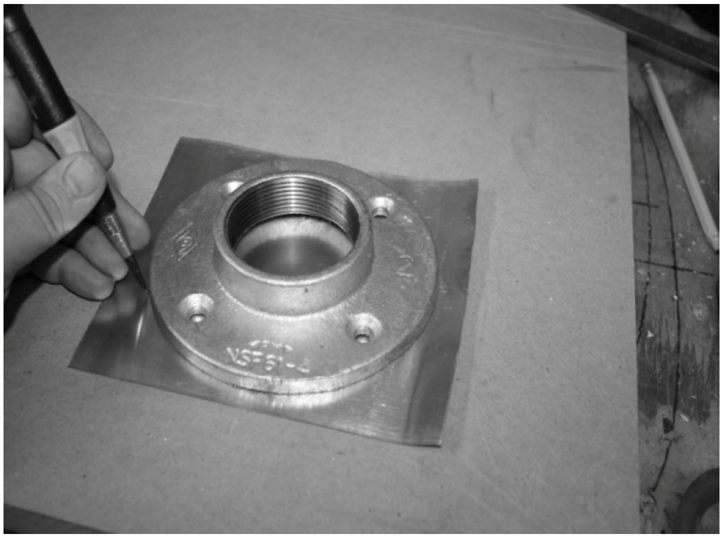


Coat the inside of the pipe where the steel and the aluminum meet. Spread it on with the piece of wood, making sure to get enough of it in place to make good contact. Fill in a little of the product around the outside half of the flashing, coating the edge to keep the thin metal from moving.

JB Weld will take several hours to set up, and overnight to cure to working strength. Do not turn on the bending iron until at least 24 hours from the time that the JB Weld was applied. Doing so can ruin the curing process, and cause the product not to harden properly. If this happens, the flashing will be able to move around inside the pipe, which can cause the heating element to be moved out of alignment.

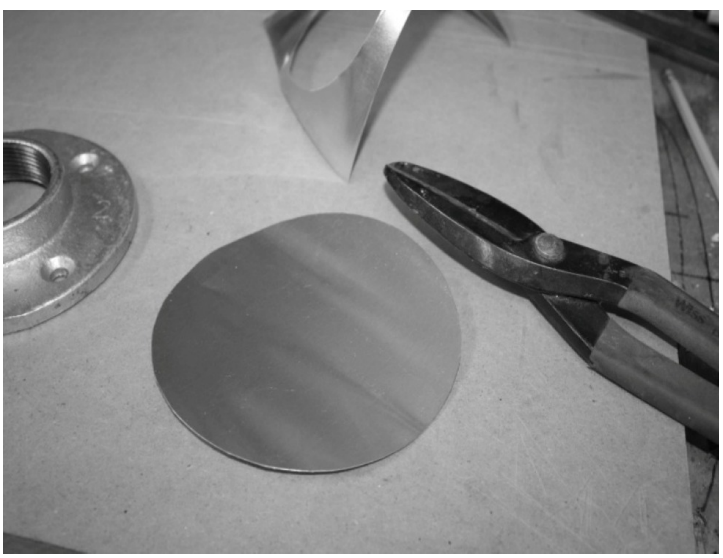
The JB Weld will need a couple hours to harden so that the final steps can be performed on the iron. While that is happening, a few other

things can be done.



A piece of flashing will go under the base flange, between the control box and the pipe. This will help prevent heat transfer between the pipe and the base, keeping the box from burning. The pipe will still make the wood hot, however this will help to prevent any actual burning or smoke.

Cut out a length of flashing from the roll that fits under the flange, and trace around it with a scribe. Make a strong mark that will be easy to see when cutting it out.

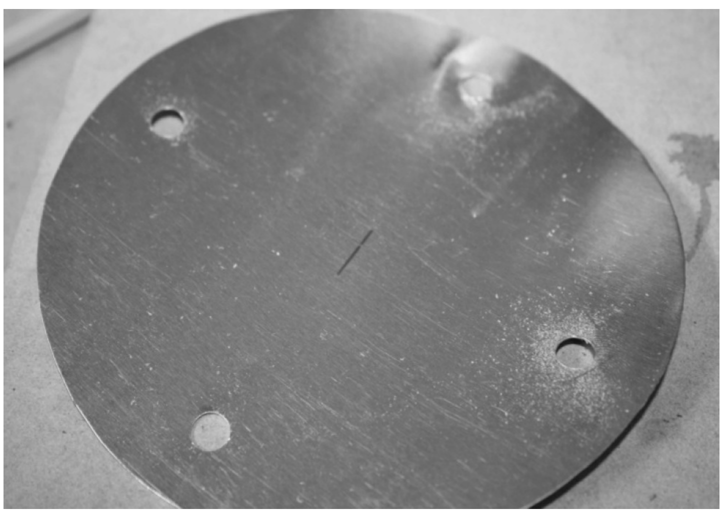


Cut out the disc that will go under the flange using a tin snips. Carefully cut following the scribed line, making smooth and even cuts all the way around the piece. Throw the excess in the trash, handling it with care to avoid being cut by the sharp edges.

Test fit the flashing to make sure it is not sticking out past the ends of the flange. Trim any edges that need to be trimmed.

Use an awl to make a mark at the center of each hole in the flange, which will be the guides for drilling.

Using a 5/16" brad point drill bit, drill out all the holes in the flashing, lining each one up carefully before actually drilling through the piece. Use a small piece of wood under the flashing to prevent the drill bit from tearing out the metal.

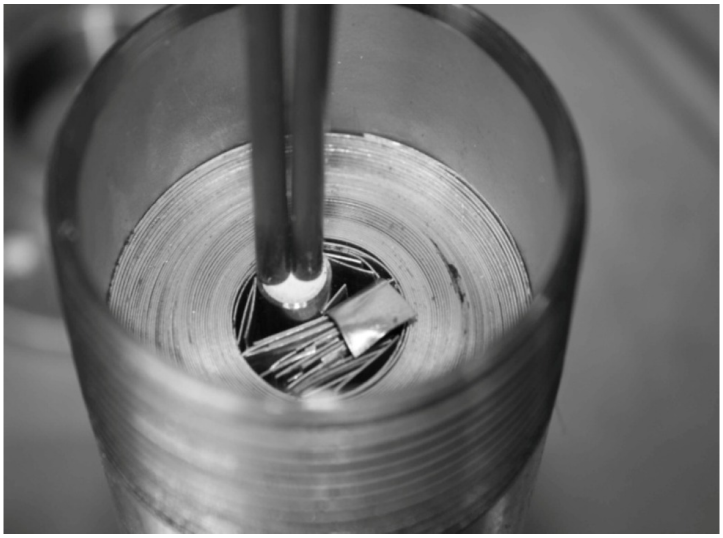


Mark the center of the flashing by connecting the holes with a ruler.

Then, drill out the center hole with the same drill bit, keeping a piece of wood under the metal to prevent tearing it.

As the JB Weld is hardening, prepare the strips that will need to be inserted into the center of the behind iron to fill the gap left by the flashing. A large number of thin strips varying from 1/2" wide to 1/8" wide will need to be cut off the end of a piece of flashing. Do not worry about getting them to the correct width, only worry about making the cuts as straight as possible. These thin pieces will be inserted one at a time into the center hole in the flashing, filling in the gaps around the cartridge heater.

More can always be cut later, but for now cut around 30 strips in varying widths.



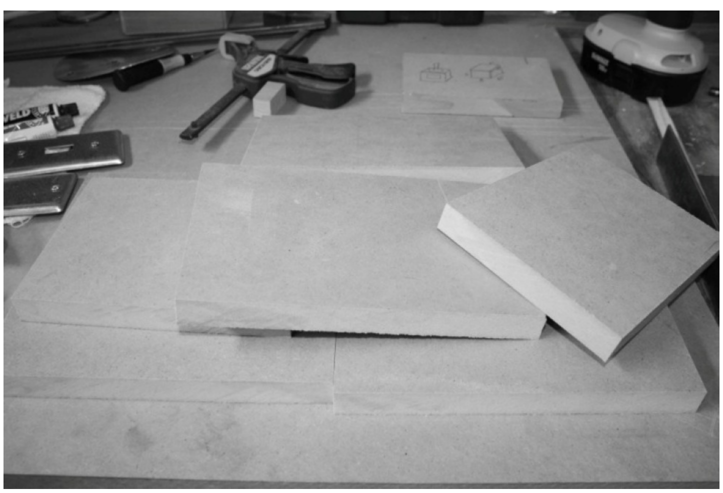
Once the JB Weld has cured enough that it can be touched with a nail and feels hard, the center of the pipe can be filled with metal strips. Insert the cartridge heater first, then begin using the larger strips to fill in the hole. Once the large strips cannot fit in anymore, grab some thinner pieces and start using those. Continue this process for as long as it takes to completely fill the center with strips. It does not matter if the cartridge heater is in the exact center of the tube, as long as it is close to the center it will work just fine.

A point will be reached when it looks like no more strips can be added to the center hole, which means the strips will need to be cut thinner than before and more must be added. Tip the pipe upwards towards a light source. This will show the areas where there are still larger gaps. Fill in any gaps that are seen until there are none remaining that can take a strip wider than 1/8".

The more strips that are added to the center hole with the cartridge heater, the better the heater will work. This is because the cartridge will need metal nearby to transfer heat to, radiating it outwards towards the metal pipe. If there are large gaps in the center around the heating element, the heat will not be transferred as well, which means the element will have to work harder to reach the same temperature.

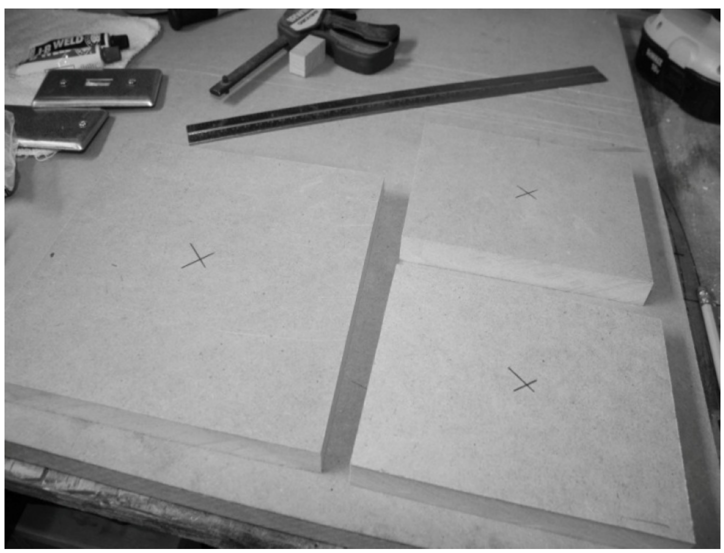
A piece of wood can be used to help press the thin pieces of metal into place, and to even them out on both sides. Sometimes a piece of metal being pushed from one end will go easier than another. This is fine as long as the pieces are fully inserted every time, filling the pipe evenly. Stop once fully confident that there is no possible way more metal could be filled in.

When the filling process has been completed, the cap and the flange can both be screwed to the pipe, completing the construction process for this part of the iron. Place the completed iron aside while the base unit is constructed.

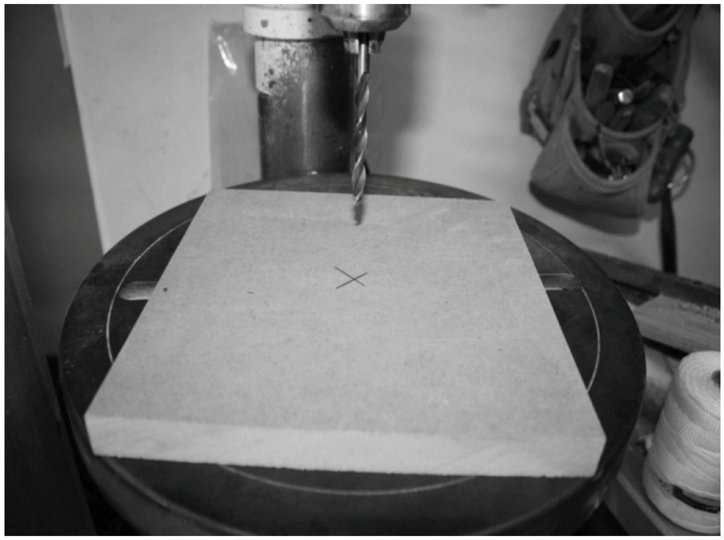


The base can be made to almost any size that comfortably holds the pipe and the rheostat controller, the sizes listed here are only one of many options, though they will work well. The base in this example will be 8" wide, 8" deep, and 6-1/2" tall, which is on the larger side. The reason for this is to allow ample air space inside where control elements are, as well as to provide some bulk to act as a counterweight while bending a piece of wood. Though it will be clamped down to the bench when in use, a little larger base helps to keep the pipe stable and be less top heavy.

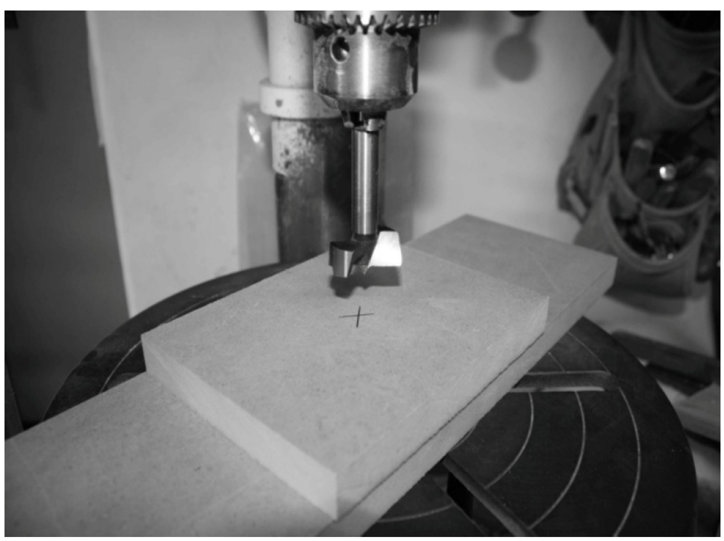
For the base, cut two pieces of 3/4 MDF that measure 8" x 8", one for the top and one for the bottom. Two sides that measure 8" x 5", and two more sides measuring 6-1/2" x 5". The larger sides will be used for the front and back while the smaller pieces will sit inside the left and right sides. Label the pieces if that makes the process go easier, though there are only six pieces to be had, so this step can be skipped if desired.



Gather one of the top pieces and the two smaller side pieces. Mark the center on each of them by using a ruler to connect the corners. Make a mark near the center, then switch the ruler to line up the other two corners and make a second mark. The place where these two lines intersect is the center of the board. This process can be used any time a center of a piece of square or rectangular wood needs to be found without measuring.



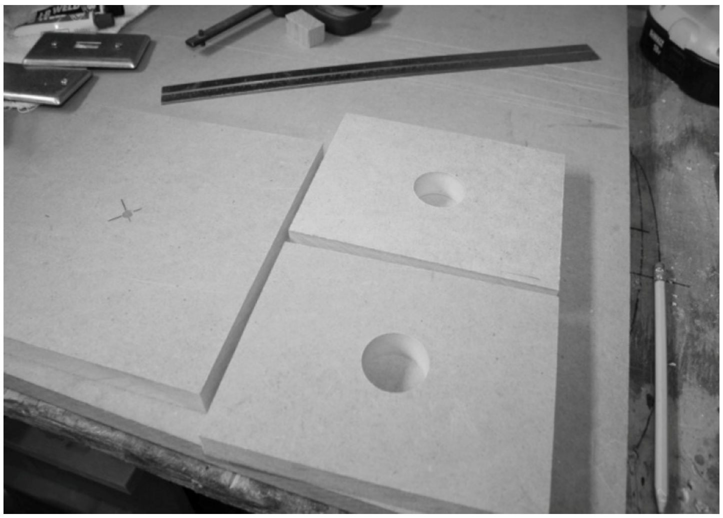
Use a 5/16" drill bit to make a hole in the center of the piece to be used for the top. Rest the piece where the drill bit can go through the hole in the center of the drill press table when it exits the MDF on the bottom. A brad point drill bit will make the process much easier as it goes where it is intended to go much better than a twist point bit.



Place a piece of scrap beneath each side piece as it is drilled on the drill press, to provide a safe backup for the Forstner bit. Chuck at least a 1-3/8" Forstner bit into the drill press and drill a large hole following the marks made earlier. These holes will be used to help ventilate the heat that

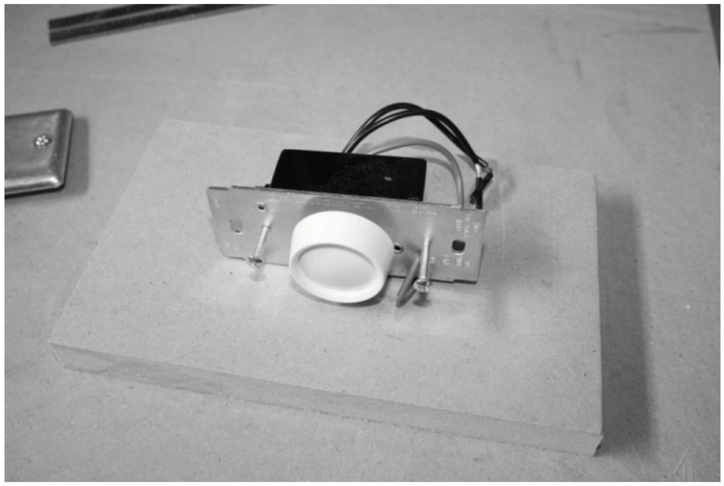
can build up in the control cavity as well as provide a couple places to attach clamps while using the iron.

Check the bar clamps in the shop to see how large the feet they have are. Test drill a couple holes into a scrap piece of wood and see if the clamps can fit into them. It does no good to drill holes that are too small to be used with the clamps that are already in the shop.

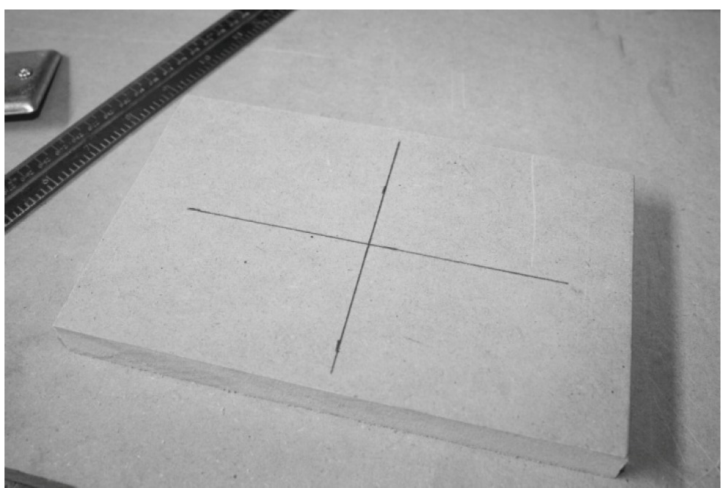


Once drilled, the pieces should look like the three in the picture above. Take the time to clear out any tears or splinters that may be left around the edges of the holes, as these pieces are essentially done at this point. Making a good looking jig is not as important as making a well functioning jig, but a little extra attention never hurt anything.

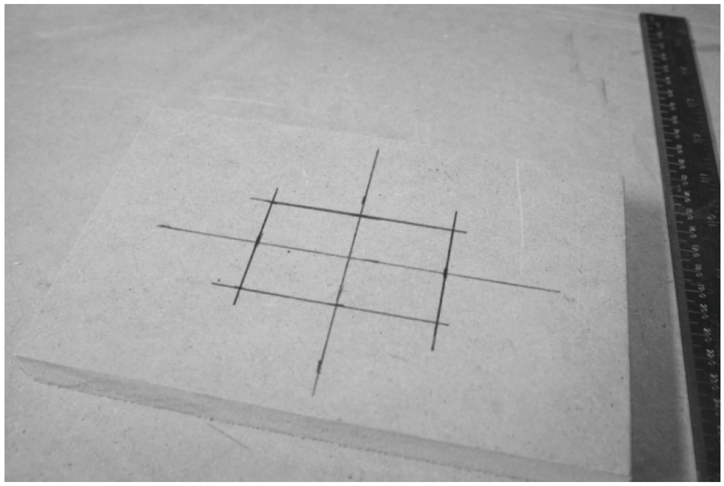
Place these three pieces aside, and grab one of the front pieces as well as the rheostat, which will be fitted in the next few steps.



The back side of the rheostat will need to be measured before it can be fitted into place. Get the measurements now and write them down somewhere.



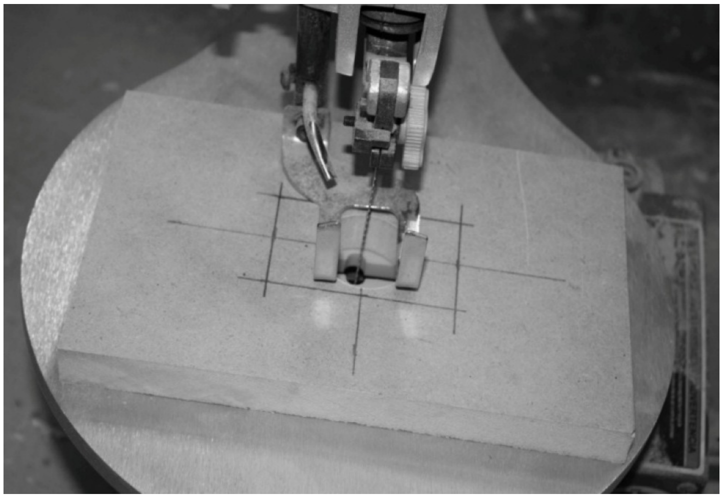
Mark the center of the board with two long lines, one that is 2-1/2 inches from the top and one that is 4" from the side.



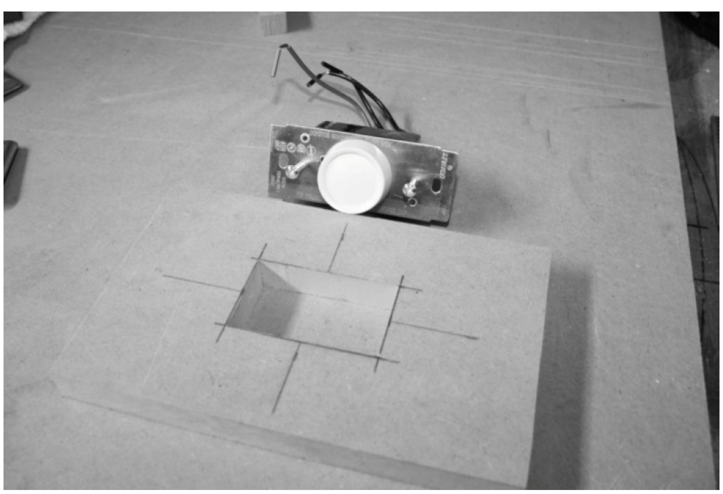
Plot out the exact measurements of the back side of the rheostat by marking around the center cross. If the unit is 2" wide, measure 1" on each side of the line and make a mark. Do the same for the height, and then connect the marks with straight lines that represent the exact size of the rheostat. Now it will be very easy to remove the area inside the lines with a scroll saw or drill and chisel, knowing that the rheostat will fit when done.

If a scroll saw or a jig saw is not available in the shop, the drill press and a chisel can be used to remove the material inside the square. Drill out as much as possible, concentrating on getting close to the line with a 1/4" drill bit, and making as many holes as can fit inside the square. Once no more holes can be made, bring out the chisel and carve away the middle portion. Take the time to straighten the walls of the hole with the flat of the

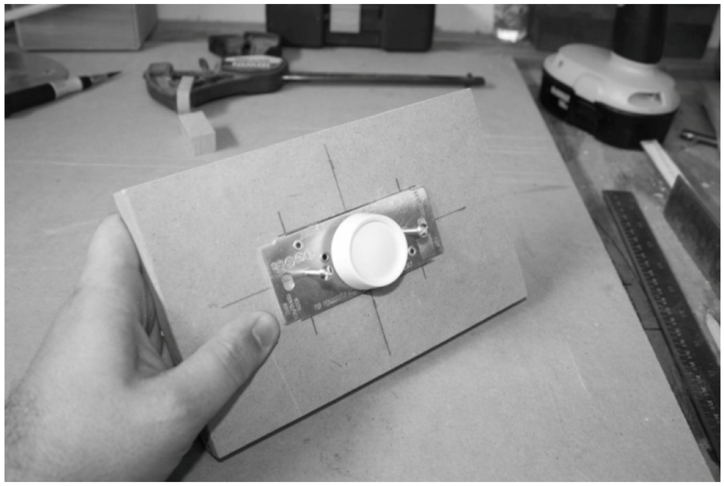
chisel, which will encourage a better fit when the rheostat is inserted. A chisel that is an inch wide is perfect size for clearing out the middle portion while keeping the walls of the hole straight.



If using a scroll saw or jig saw, this process is as easy as drilling a hole large enough for the blade to pass through the center, then sawing out the piece. A small scroll saw like the one seen in the pictures is not very expensive, and makes doing an inside cut like this very quick and easy. Remove the piece from the tool when finished, and bring it back to the bench for final fitting.



Gather the rheostat and the front piece with the newly made hole.

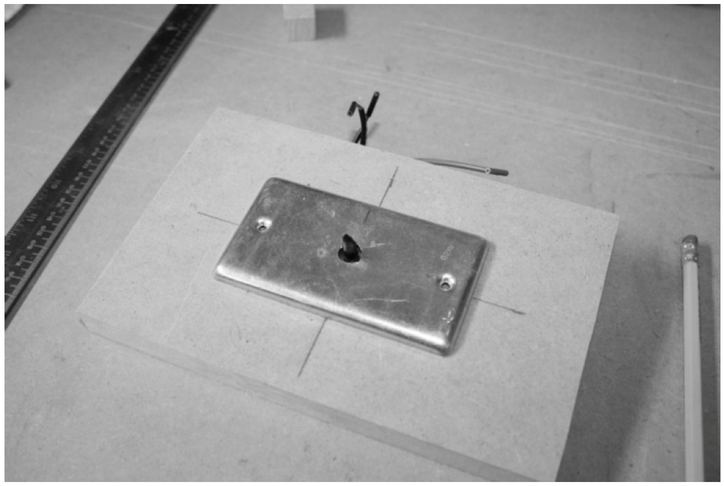


Insert the wires through the hole first, then the rest of the rheostat housing. Do not press too hard, if the piece will not go just remove more wood until it fits nicely.

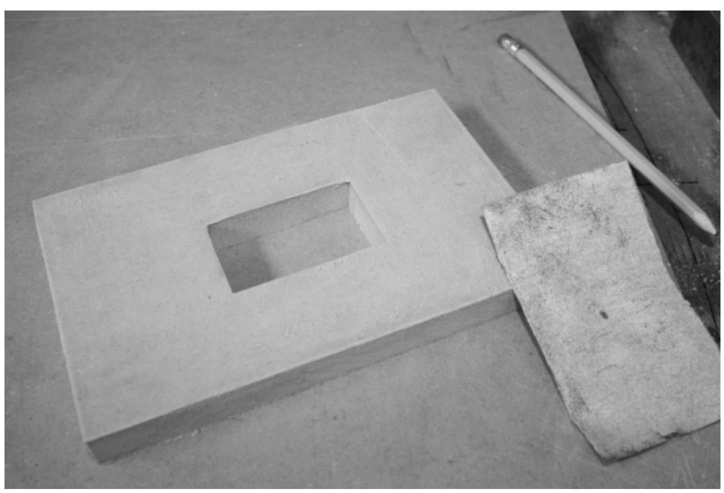
To measure the plate cover for the center hole, lay the cover against the rheostat, lining it up evenly from left to right. Mark a line where the adjustment shaft is, which will be the center of the plate. The screw holes can be used for marking the center of the other side.

Join the two marks in the middle to mark the center point where a hole will need to be drilled to allow the post through.

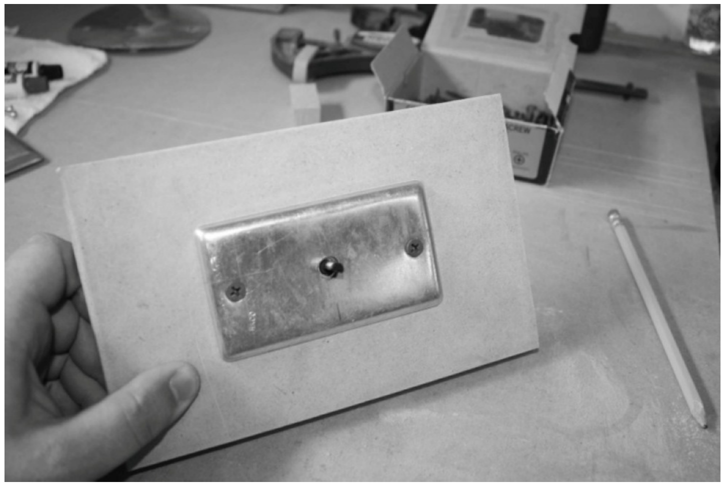
Lay the plate cover on a piece of scrap wood to keep it from bending, and drill a hole through the center, following the mark. The hole should be 5/16", or larger if the rheostat being used requires a larger hole.



Place the switch plate over the rheostat to check the fit. The center post should pass through the plate freely, and without getting stuck on the sides. A good way to see if the plate is lined up well is to look through the two holes. They should line up with the two holes in the rheostat, which will allow everything to be screwed to the front of the bending iron.

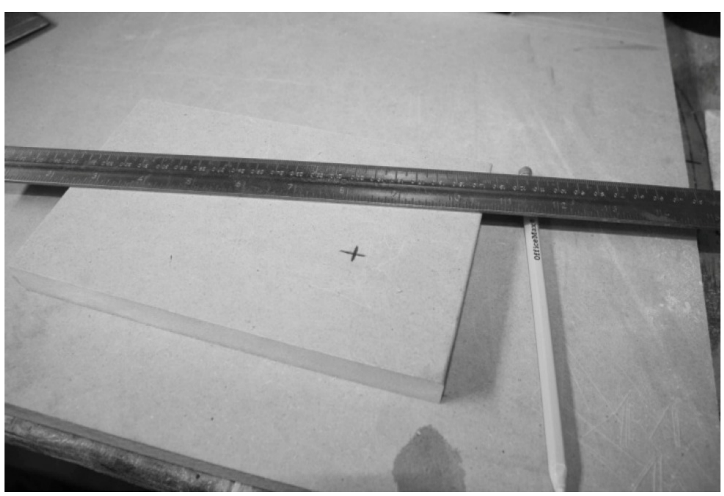


Remove the plate and the rheostat from the front piece, and remove the lines made on the surface using a piece of sandpaper. This is not completely necessary, though it will make for a better looking bender once completed. A small piece of 150 grit paper makes short work of the pencil marks, and a brief sanding of the entire face makes the piece look even again.



Assemble the rheostat and plate again into the front piece, getting them ready to be screwed into place. Use a pair of wood screws that are at least 3/4" long, though the length does not matter as much as that they go all the way through the MDF. The screws in this case were 1-1/2", and the ends stick out on the other side. Since the ends are going to be inside the bender, there is no reason to worry about having exactly the right length of screw.

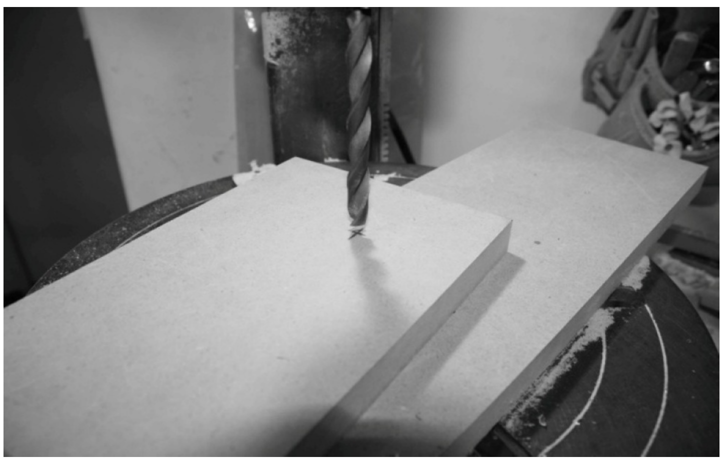
Set this piece aside for the time being, as the front face is completed at this point. Once the rheostat is screwed to the front piece, it will not be needed again until final assembly.



Find the piece to be used for the rear side of the box, which will be 8" x 5", the same size as the piece for the front of the box used earlier.

This will be where the power cord will pass through, and a hole will need to be made to accommodate it. If the bender will be used horizontally, send the cord out of the side instead of the back by making a hole that is the same distance from the lower corner. This way it can be laid down without smashing the cord.

Measure two inches from the bottom of the piece as well as from the right side of the piece and make a pair of marks. The intersection point of these marks is where a hole will need to be drilled, and which the cord will be threaded through.

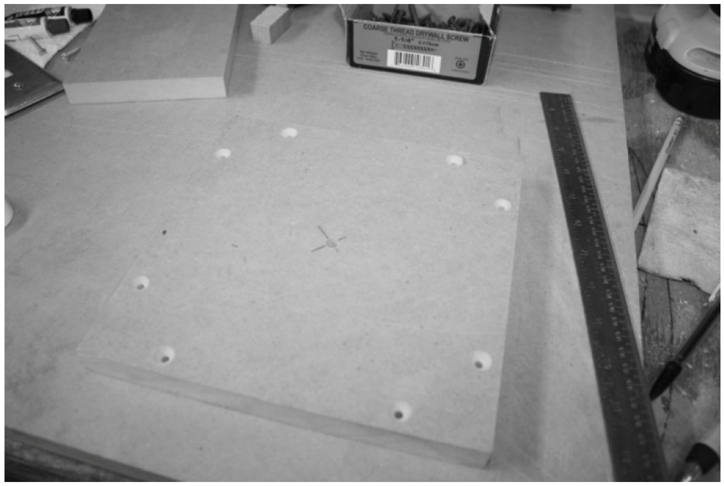


Depending on the cord that was chosen at the hardware store, the size of this hole can vary significantly. Only the diameter of the cord itself and not the plug will need to pass through the wood, so select a drill bit that is large enough for the cord to pass, and chuck it in the drill press.

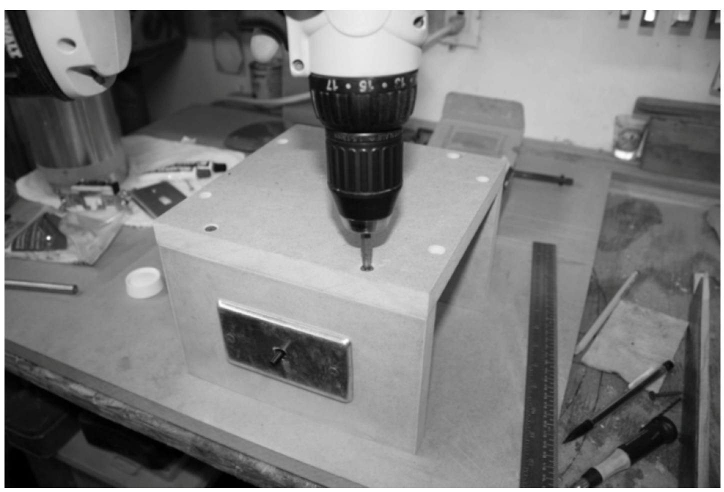
Lay the piece of wood on the drill press table, and drill through the marks. Test fit the cord by trying to push the end through the hole. If the hole needs to be drilled larger, switch to a larger drill bit and send it through the hole again. Stop once a hole is made that allows the cord to go through easily without having to be pulled very hard.

Place the back piece to the side and bring the top piece to the bench. Measure around the edge for the screw locations, which will hold the side pieces to the top plate. These should all be 3/8" from the edge, which will place them right in the center of the boards they will be screwed to. They should also be right around two inches from each corner. Do this with a ruler because the screw heads will be visible once the construction process is complete, and at least the screws on the top should be even for a nicer look.

Drill the marked locations completely through using a drill bit that is large enough to allow the wood screw to pass through the board without catching, and no larger. Measure the screw threads with a caliper, and select a drill bit that is the same size. This way the screw threads will grab the bottom piece and pull it towards the top piece, without catching the threads on the pilot hole.



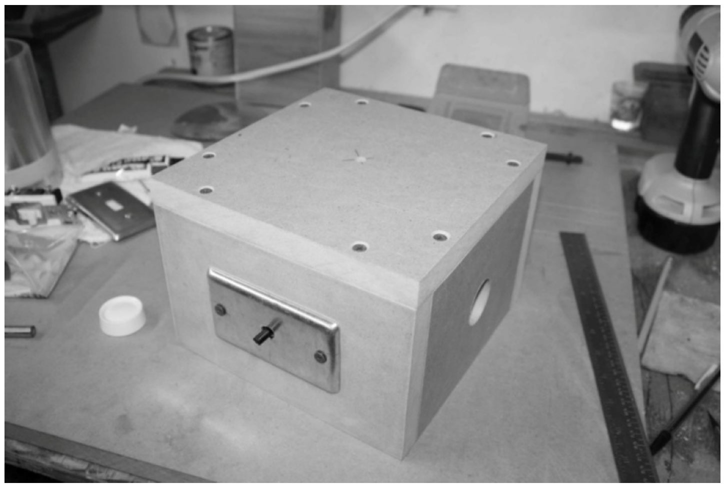
After the piece has been drilled, switch to a countersink bit, and use it on each one of the holes, making space for all the screw heads. This bit removes wood quickly, so set a depth stop on the drill press once the right depth is discovered on the first hole. Drill the rest of them the same way and they will all have an even sinking of the heads. This will keep the screw heads from catching on clamps, fingers, and keep them flush and out of the way. Repeat the drilling and countersinking procedure on the other 8" x 8" piece meant to be used for the bottom.



Place the front and back pieces on the bench, and stand them in their approximate positions. On top of them place the top piece, which is the one with the hole in the center. Carefully line up and screw the top piece

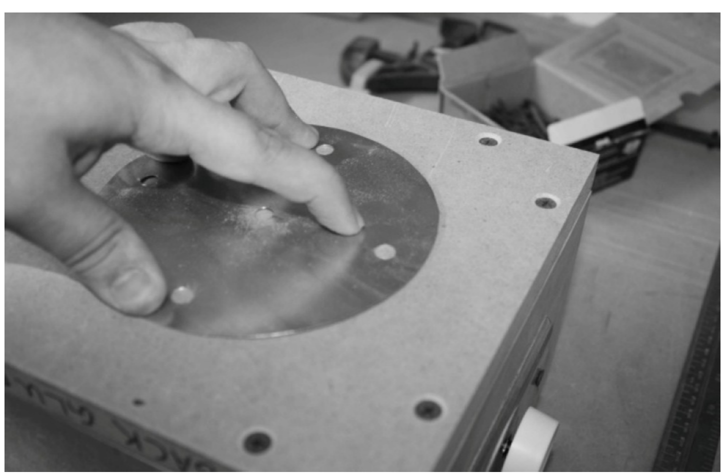
to the front piece, using a pair of wood screws in the pre-drilled holes. Do not pilot the side pieces, as the wood screws should not split them.

The back piece is placed under the top as well, only to keep it in the air during the attachment process. Once the front piece is attached, the back piece can also be attached the same way.

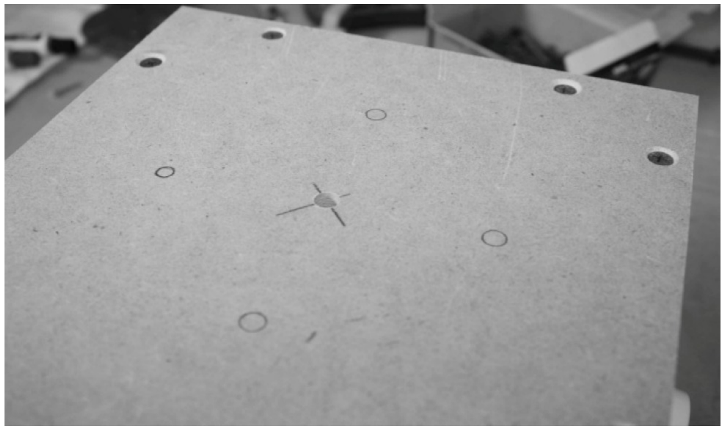


Insert the side pieces in between the front and back pieces by sliding them in place. These are the ones that have the holes drilled in them for ventilation and for clamping holds. Send a couple screws through the top of the box, locking the sides in place.

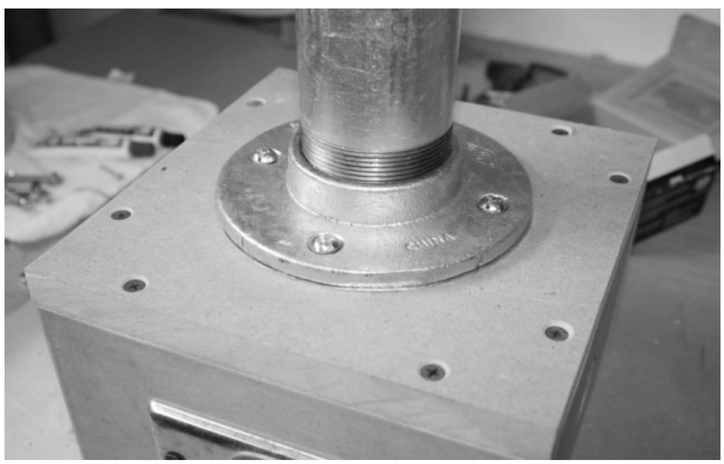
Check the screw heads around the top and make sure they are all sunk below the surface evenly, and none are sticking out above it. The box is now ready to have the iron attached to it.



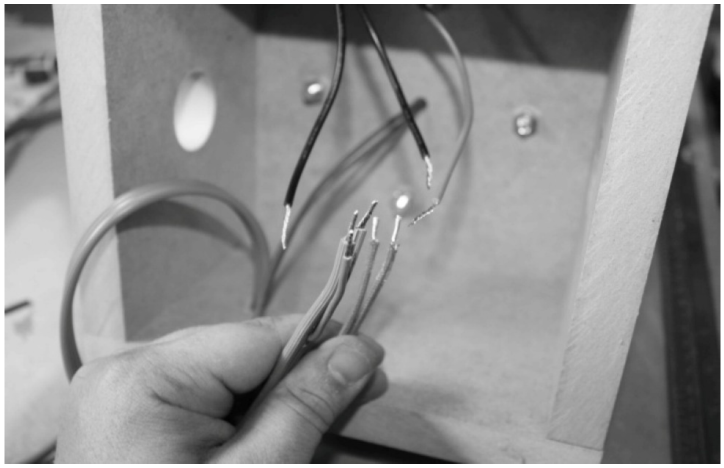
Place the aluminum disc for the base of the iron over the center hole on the top of the bender.



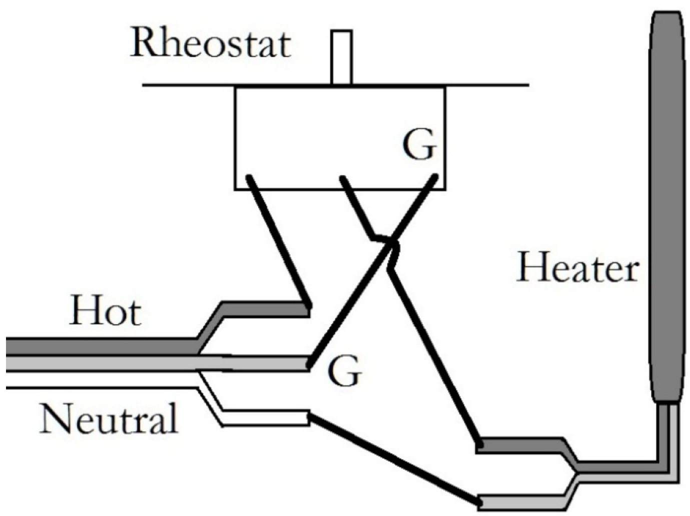
Mark out the holes that are in the disc onto the surface of the top, clearly showing where the drill holes will need to be placed. Drill with a 5/16" bit.



Place the aluminum flashing for the pipe base over the wires and onto the flange. Line up the holes, and place the whole thing over the top of the box, sending the wires through the hole in the center of the base. Line up the holes, and insert four 1/4-20 screws that are 2" long through the top. On the bottom side attach a set of nuts, and tighten them down with a crescent wrench and screw driver. Screw the nuts on very tightly.



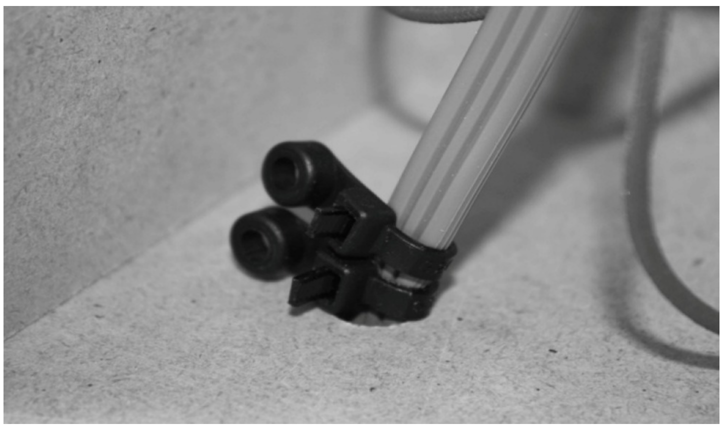
Lay the unit on its side to expose the bottom end and the wires, and insert the end of the power cord through the hole on the rear side. Bare the last half an inch of wire on each element, so they are ready to be connected with wire nuts.



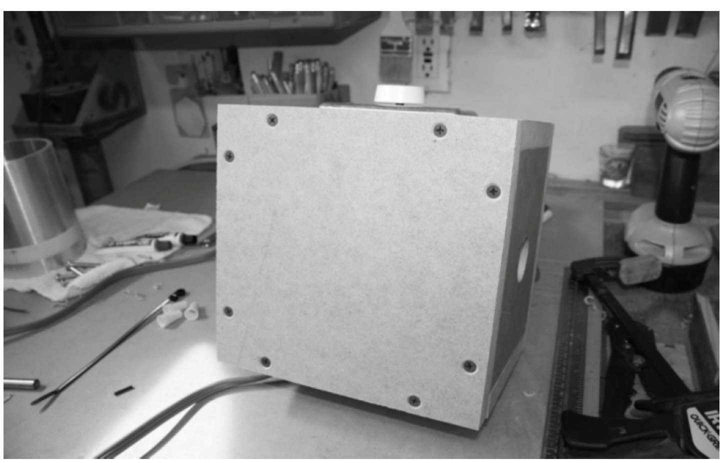
The wiring diagram can be seen above, and this assumes the wiring is similar in other parts of the world as it is in the United States. Essentially, the hot lead on the power cord will need to be broken by the switch (the hot is typically the smooth wire) and then attached to the heating element. The other wire from the heating element attaches to the neutral wire from the power cord, and the ground from the power cord attaches to the ground on the rheostat.

There is not a definite positive or neutral on the cartridge heater, and unless it is marked it will work with either wire. Use a good quality wire nut to make the connections under the iron, as they will easily be able to be disconnected for any possible repair in the future.

The actual wiring may be different depending on what country this is made in and what components are purchased. If lacking in electrical experience, have someone who knows more about it wire the unit, and as always keep the unit unplugged while working on it.

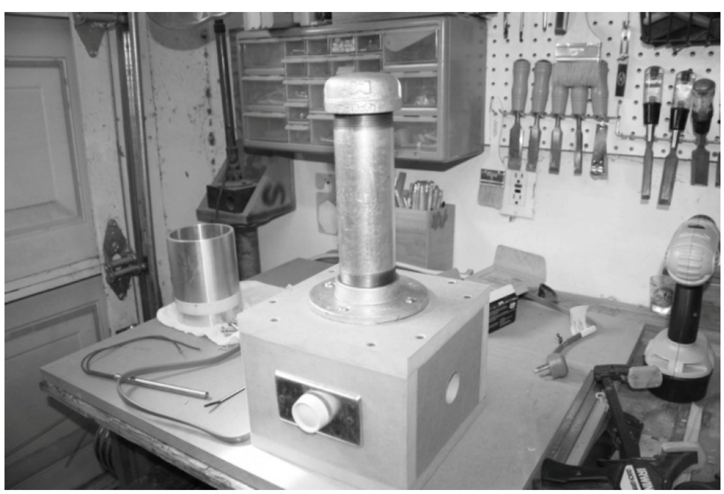


Before closing the box, attach a couple zip ties around the power cord on the inside, which will prevent the cord from being pulled too hard and separating on the inside.



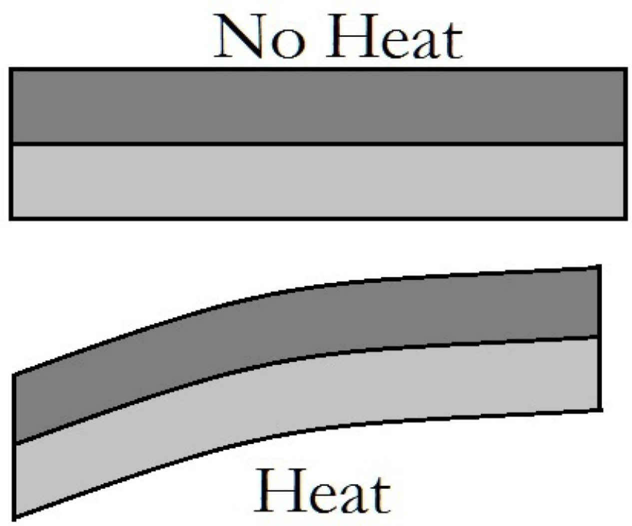
Seal up the bottom of the box with eight more wood screws, but do not add glue. The bottom will need to be removed should the unit need repair.

Stand the unit upright and as long as it has been 24 hours since using the JB Weld, plug it in and turn it on. There should be a faint humming from the unit, indicating that the element is working. Some testing will be needed to see where the dial needs to be for the temperature to be right. Spend a little time getting to know the iron before bending any sides.



There are a few more options for the electronic bending iron that are worth mentioning, as well as a warning. The temperature regulation can

be taken to the next level by using a device called a thermocouple, which will keep the iron at a certain temperature as long as it is on. Also, adding a thermometer to the unit can help provide an instant temperature read out. Finally, a cartridge heater is capable of burning down the house if left unattended, and extreme care needs to be exercised when working with such a hot object.



Thermocouples work in a number of ways, however the most simple is through the use of a bimetallic strip. This is a laminated strip made from two metals, and when exposed to heat they bend. The temperature required to bend the strip can be varied by the thickness of the strip used as well as the metals it is made from. Essentially, when the iron gets too hot, the strip bends, disconnecting the electricity, and killing the heater. Once the temperature drops enough, the strip will bend back, reconnect the circuit, and start the heating element again.

The more advanced units are completely controlled by a computer, and a wire lead or probe does the temperature measuring. These are a bit more expensive, however they can easily be wired to the existing iron. Of course, testing the iron with a thermometer to figure out where the settings need to be in order to get the right temperature will also work, and requires only a little more patience.

Speaking of thermometers, a small thermometer can be attached to the bending iron as well, which will give an instant readout of the temperature. It is best to attach it to the end of the pipe, which will keep it

out of the way of the bending action, and be close enough to give an accurate reading. A candy thermometer or any other thermometer capable of reading 300-500 degrees will be perfect, since usually around 400 degrees is perfect bending temperature. This can be attached to the pipe with some JB Weld, or a hole can be drilled through the end and the stem inserted.

If inserting a step of a thermometer, the aluminum flashing will also need to be drilled out near the actual pipe, because it will be impossible to press it between the highly compacted layers. Also, inserting the thermometer near the heating element will give false readings. Placing the stem of the thermometer as close to the inside face of the pipe as possible will give the best and most reliable readings of the actual iron temperature.

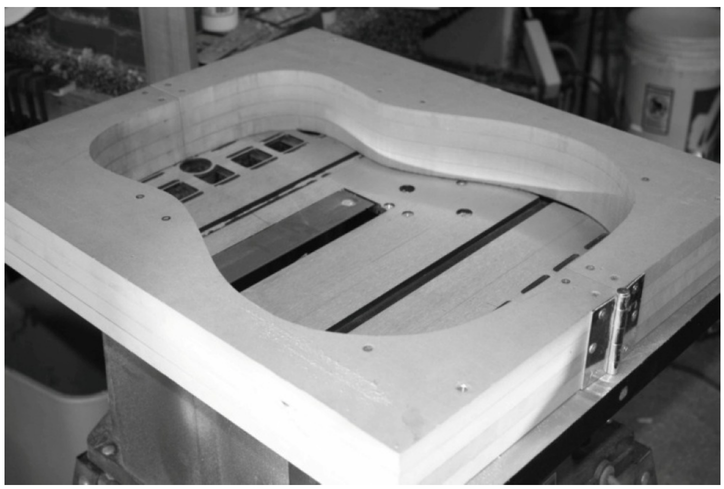
Finally, as with any tool that is made by hand and uses electricity, it is always good practice to turn off and un-plug the unit after use, in order to reduce the chances of a fire. This is a very powerful piece of equipment, and the cartridge heater will be able to get hot enough to burn anything the iron touches. If the unit is left unattended, or the rheostat is turned too far up, the iron can super heat and catch fire.

Making something like this requires some knowledge of electricity as well as accepting a degree of risk while operating it. Anyone who feels that the risks outweigh the benefits are encouraged to purchase a bending iron from a company instead of making one at home. However, the same rules will apply when it comes to turning off and unplugging it while not in use, and just being careful around the tool in general.

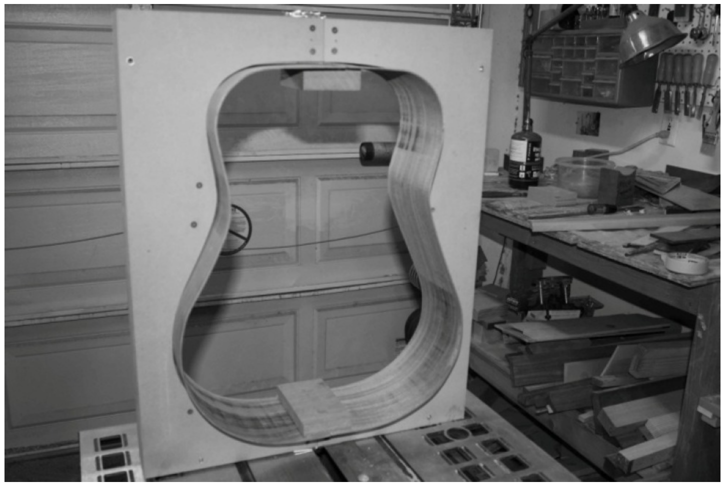
Exercise caution any time the electric bender is being used, and always monitor the temperature by using a thermometer or watching to see if the wood is scorching quickly. If the temperature looks to be rising rapidly, pull the plug and turn off the unit until it reaches a lower temperature, then plug it back in and leave the element on a very low setting until it warms up again. It is better to start low and work up to temperature, rather than get it so hot that it becomes dangerous. The risk in operating a tool like this is yours and yours alone.

THE OUTSIDE MOLD

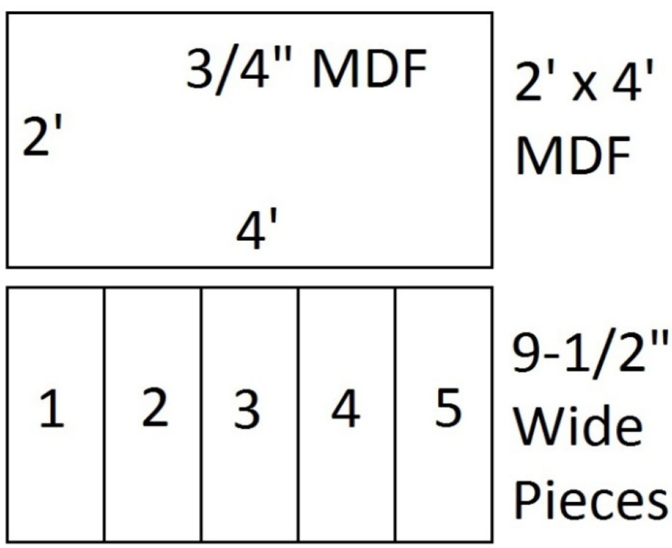
The most reliable way to craft uniform and consistent guitars is to use a body mold. These are made from MDF or plywood, and they allow the body to be constructed in a specific space. All guitars exiting the mold will have the same body shape, as well as have sides that are a perfect 90 degrees to the top and back plates. This makes for an easier time working on the guitar, as well as a better looking and sounding guitar in the end.



The mold itself is fairly simple to construct, and can be done very quickly if a router or router table is available in the shop. The outside mold is a set of stacked MDF pieces or plywood pieces that have half the guitar profile cut into them. They are stacked and screwed together evenly, and allowed to open with a hinge on one end and a draw catch at the other.



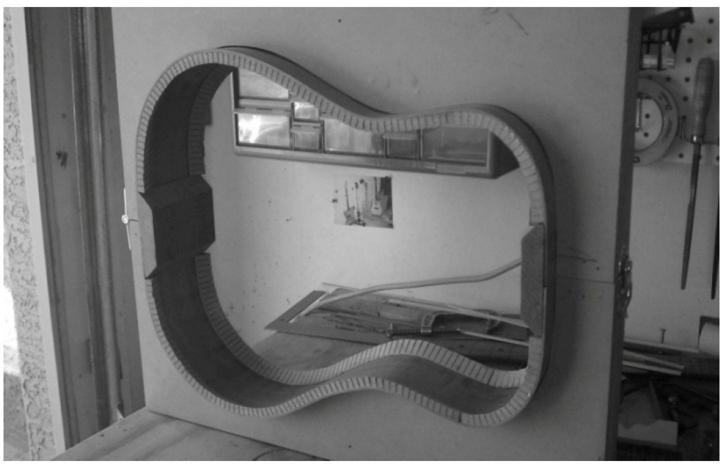
When building the guitar, the sides are bent on the pipe and then clamped into the mold where they will cool. Since they are clamped to the same shape as the mold, which is also the same shape they are bent to, they retain that shape very well. Also, since the sides of the mold are 90 degrees to the faces, the sides themselves are perfectly straight and even all the way around the piece. This is hard to do without a mold, especially when gluing everything together. It is far too much to have to monitor when also trying to get a hundred clamps in place before the glue sets up.



The mold itself can be made from MDF or plywood, though MDF will be better because it is softer on the guitar sides and easier in

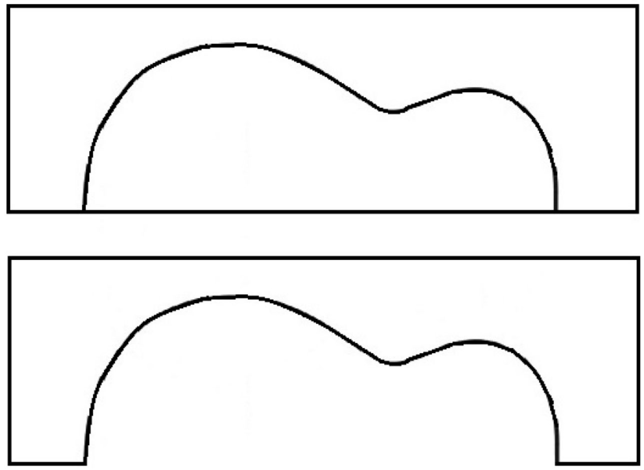
general to shape and sand. Also, it will never warp, bend, or twist with humidity changes in the shop. Plywood has similar properties, however the clear advantage goes to MDF for the softer edges and the fact that it is manufactured dead flat.

Two pieces of MDF that are 3/4" thick and measure 2' x 4' will be needed, one for each half of the mold. These can be found in any hardware store, and are a little more expensive than plywood, but well worth the difference. This mold will be in use for as long as guitars are being made in the shop, and will never need replacing unless built poorly.



Rip off several pieces on the table saw that are 24" long and just a fraction under 9-1/2" wide. There should be just enough waste left at under 9-1/2" to get 5 pieces plus blade waste out of the large piece of MDF. Do the absolute best to keep the pieces as straight as possible through this process, because they will need to line up well when they are assembled later on. Angled cuts and poor cuts will not line up well, and the mold will look rougher than it should.

If making a mold for a thinner guitar, only 4 pieces will be needed on each side, however a full bodied dreadnought can have up to 5 pieces which will total a height of 3-3/4" for the mold. Look at the individual guitar being made, and build the mold so that the total thickness is 1/2" to 1" less than the thickness of the guitar at the shoulders. This will allow an area that can be planed down when the back is tapered.

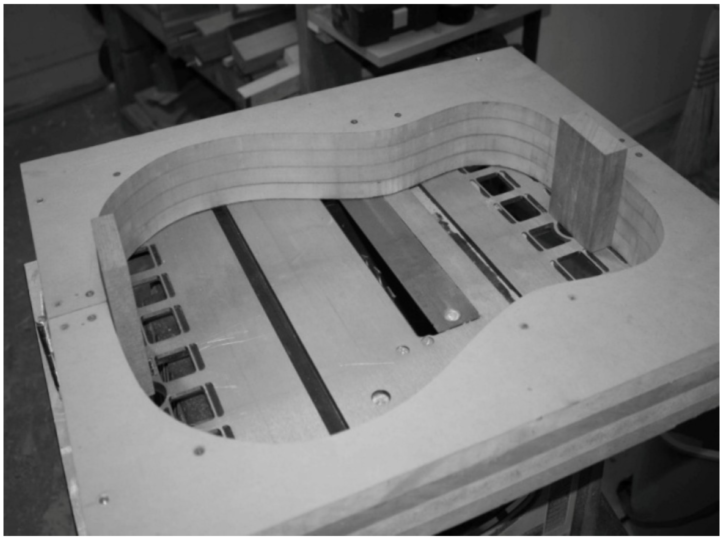


Begin with one of the pieces and draft the half profile of the guitar onto it. Follow an existing plan and trace that half image onto the wood, or simply measure out a guitar and draw the shape by hand. The advantage to this kind of construction is that only half of the guitar shape will need to be drawn, as the rest will be duplicated from this main piece. Even if the shape is drawn by hand, the other half will be an exact reflection, and therefore look even and symmetrical.

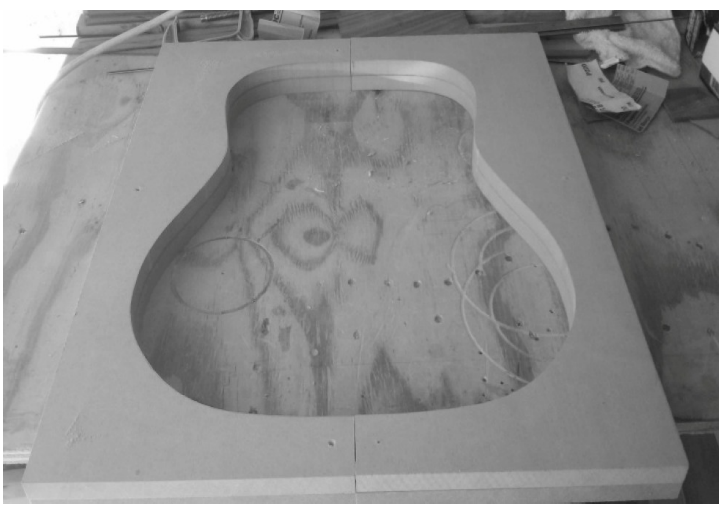
Bring the piece to the band saw or the jig saw, and cut as close to that line as possible without going over it. Be careful when making this cut, and be sure not to deviate from the line at all. Take the time to make the cut well, because it will reduce the amount of time that will have to be spent sanding and refining the shape later, which will need to be done before the rest of the pieces are duplicated.

After sawing, bring the piece over to the bench and use a curved sanding block to bring the wood right to the line. MDF is much easier to sand than plywood, which is another great reason to choose it for this project. Pay attention to the angle of the block while sanding though, to ensure that the edges are kept at 90 degrees. If the guitar profile is beveled at all, the mold will not be as functional when the pieces are stacked up.

Once the profile has been sanded, blow off the sanding dust and check that all saw marks have been removed by the sander. Go over the areas that need attention again, using long strokes that will blend these areas rather than dig them too deeply.



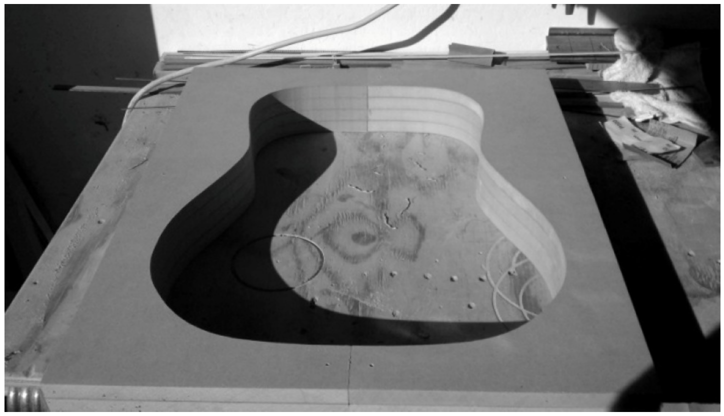
Spend some time on this master board, as it will directly determine how the rest of the pieces will look, and subsequently the mold itself. A few extra minutes sanding and shaping will pay off dramatically once the mold is made. This will essentially be the template for the rest of the mold, so make it perfectly and the mold will be perfect as well.



Use the master board to trace the side profile of the guitar on to every one of the pieces that were cut out earlier. Make sure to line the edges of the pieces up well before marking them, as this will be important later.

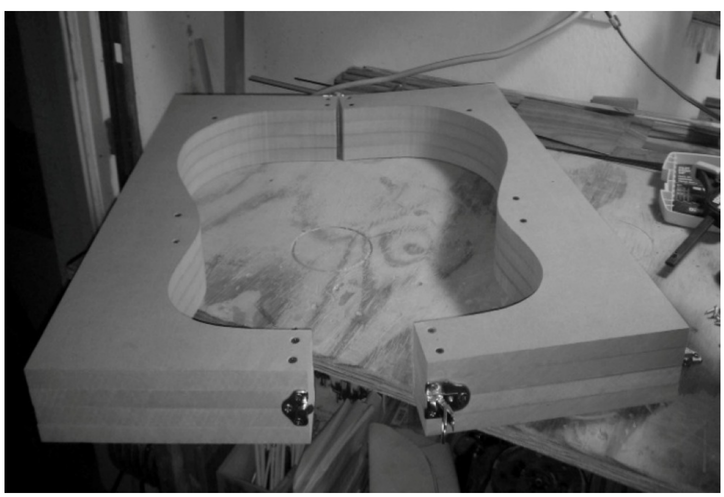
Cut out the center sections on the band saw or jig saw, leaving 1/8" - 1/4" of waste remaining to be removed. The goal of this cut is to

remove the bulk of the waste rather than actually cut on the line.



Once all the boards have been cut, screw the master board to one of them, making sure to line up the edges well as before. The screws are temporary, and serve only to hold the boards together while being routed. A flush trimming router bit can them be used to follow the master board as a guide and duplicate the profile on the other board.

Unscrew the master board and fasten it to the next piece with screws. Route it as well with the flush trimming bit, and repeat this procedure until all the pieces have been trimmed.



Stack up 4-5 of the pieces per side, and even their edges well. If the edges were evened out each time as described earlier this should also line up well at this point. It is more important that the insides cut with the

router line up better than the outsides, so check this area thoroughly after squaring the edges.

Once satisfied with the stack, check to see that the profile area is 90 degrees to the workbench with a square. If it is, clamp the pieces hard to the bench and begin screwing them together.

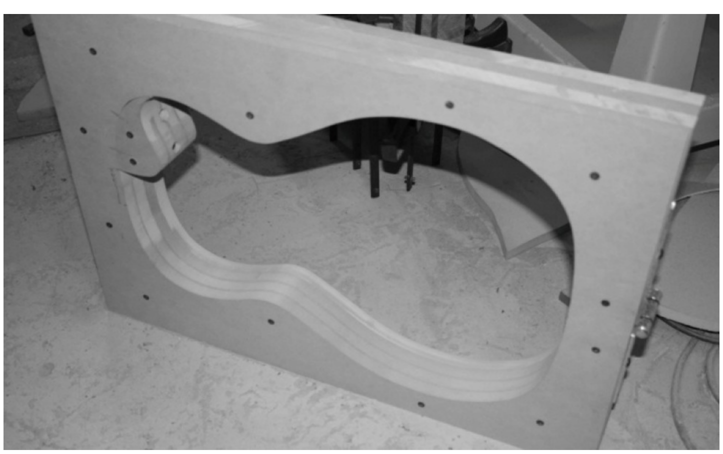
Looking at the picture above, a pair of wood screws placed at the neck area, waist, and tail block area will do fine to keep the mold from separating during use.

Repeat this procedure on the other side of the mold, checking for square constantly and making sure the pieces are aligned well. Once correct, clamp them to the bench and screw them together.

Place the two halves together to form a guitar shape in the middle, and line them up evenly. On the tail end, screw a large hinge, which will allow the mold to open when needed. This hinge needs to be a heavy duty hinge with thick screws. If the screws that come with the hinge are wimpy looking, buy new screws from the hardware store before leaving.

On the other side, purchase a draw hasp which will be used to quickly lock and unlock the guitar mold. A draw hasp is the mechanism used to close and open most older tool boxes that were still made of metal. A metal bar flips over a catch and a piece is pressed down to apply tension between the top and bottom of the hasp. This tension holds the pieces together in the same way the lid of a tool box is held down. Sometimes they are hard to find, though they can always be purchased online.

At this point the mold is complete, and can be left unfinished or coated with a light layer of varnish to help preserve it. Unless the MDF gets soaking wet, it will not have any problems if it is left unfinished.

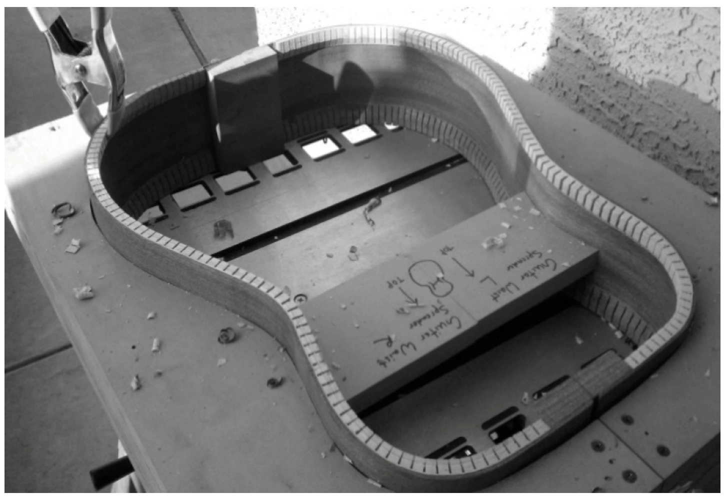


The only down side to a mold is that a different one will be needed for each body style of guitar made in the shop. Since they do not take too long to make however, the time spent is well worth the benefits it will provide. Being able to reliably make guitars with straight and even sides and a dead on profile shape is definitely worth taking a couple hours and making a mold.

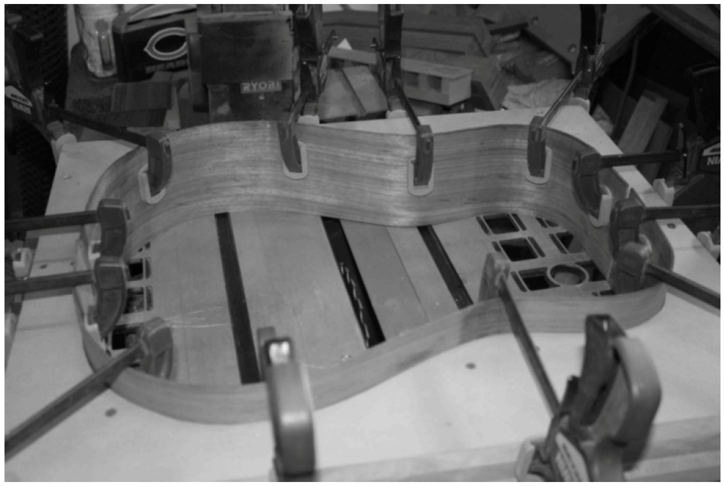
All the molds in the previous pictures with the exception of the one directly above are for a 16" dreadnought shape. The picture seen above is a smaller 15" Orchestra Model shape, with a removable cutaway insert. These molds are all flat, and store easily below the bench stacked like large books. When a particular guitar is to be made, the proper mold is retrieved and most of the body construction takes place inside it. They are a great item to have in the shop, and will help produce great guitars.

GUITAR MOLD SPREADERS

When using the guitar mold, it is useful to have a method of holding the sides against the mold without having to use several clamps. A side spreader can be made from a piece of MDF or scrap that will hold the sides against the mold tightly, and be easy to remove when needed.

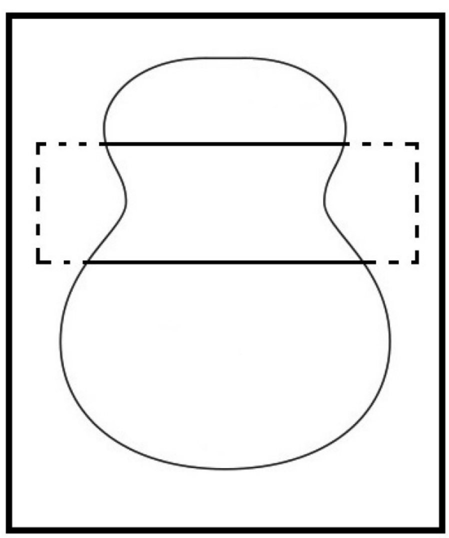


This simple spreader works by using pressure to hold the two pieces together as they also hold the sides in place in the mold. Since most guitar sides will be very close to the same thickness, only one needs to be made for each mold. Also, since the piece being made can be from scrap, the cost is very low too.



Start by having a bent set of sides in the mold, with them held tightly against the form by several strong clamps. It is very important to get them completely flush against the sides because this will be used to measure for the spreader. If the sides are not completely flat, the spreader will be made too short, and every guitar made from this setup will have slightly crooked sides as well.

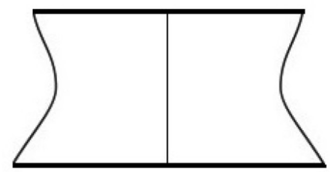
Once the mold and a set of bent sides are well clamped, set the whole unit on top of a board that is 4/4 thick, 3" wide, and 14" long. The board should show through the bottom of the mold and be positioned at the waist.



The mold and the board should be laid out as in the diagram above, with the board below the mold, and evenly placed at the waist. The clamps and sides should still be there, though they are not drawn into the diagram.

Trace the outline of the waist onto the piece of wood with a sharp pencil, as close to the sides as possible. Once the marks have been made, the piece can be removed and the mold set to the side.

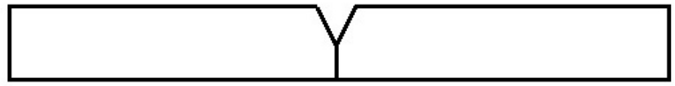
On the band saw, cut just outside the outline drawn on the spreaders, and refine the edge with a belt sander or curved sanding block.



Draw a center line as in the diagram above, and cut it out with a thin kerfed saw blade on the band saw or table saw. Try not to remove more wood than necessary, since this will affect the fit.

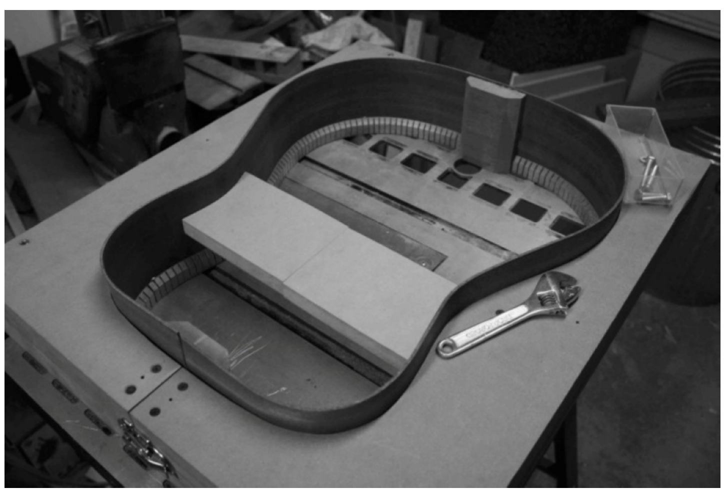
There needs to be a tiny bit of wiggle room in order for this spreader to work properly, which means that sawing out a thin line to remove a little material is actually an important part of the building process. If a thin kerf blade is not available in the shop, simply make the vertical cut first before placing the board under the mold to mark the waist. Make sure the two pieces are pressed together tightly when doing it this way, and mark the waist profiles on each side.

With the boards marked this way, cut each one individually on the band saw the same way as before, and sand down to the line accurately. Either way this is done, proceed to the next step once the center line has been cut.



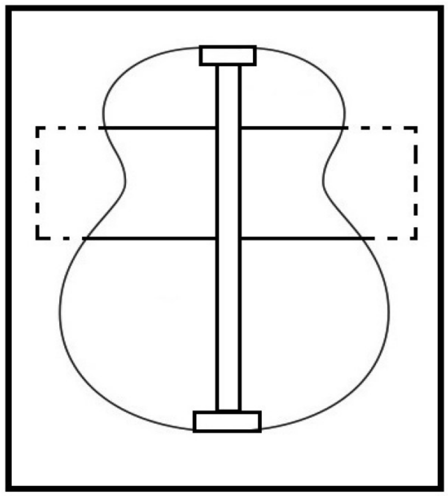
In order to be able to separate the pieces for removal from the guitar once they are no longer needed, a small notch needs to be created. This will allow the pieces to be pressed at the center, causing the pressure joint in the middle to fail, and the pieces to simply fall down. Once they have fallen, they can be removed from the guitar.

The reason these pieces are made only 3" wide is so they can be pulled from the guitar soundhole after the entire body has been glued up. If they are any larger, they will not be able to be pulled out of the soundhole, and a large rattle will have been made instead of a guitar.



These spreaders are meant to be left inside the guitar the entire time it is in the mold, and pulled out through the soundhole after the plates have been glued into place. If the soundhole on the guitar being worked on is smaller than the width of the spreaders, make them thinner with a quick

run through the band saw or table saw. Also, if a larger soundhole is being made, or an oval soundhole, feel free to use a wider piece for the spreader, which will distribute the force better.



Lastly, another spreader can be made in the same way as the first one, but for the top and bottom of the guitar. This should be made form a longer and thinner piece, so it can be removed from the soundhole as well. Make sure the end blocks are already in place before measuring out for this spreader, because it will be too long otherwise.

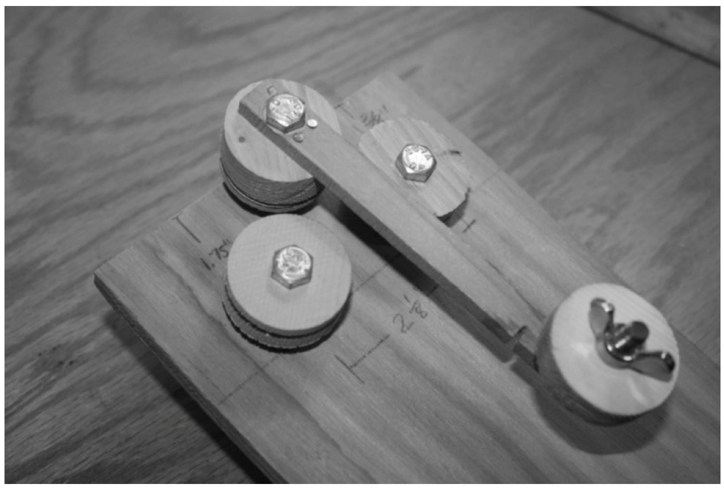
When making the guitar body in the mold, place the side spreaders in as one piece from the top, positioning them at the waist, about half way up the side of the mold. Glue the head and tail block in place, and then add the vertical spreader once the glue has dried and the clamps are removed. With both spreaders in place, the kerfing and the plates can be glued on in order and left to dry overnight. The following morning, press on the centers of each spreader and they will collapse under their own pressure. Remove them from the soundhole, and proceed to the next step on the body.

Only one set of spreaders should need to be made for each mold, since the sides and thicknesses of the head/tail blocks will typically be very similar. When using the spreaders, insert them carefully so not to crack or crush the sides. A snug fit is a good thing, however it should not be frightening to insert these pieces. If they are hard to place, simply hand sand one of the spreaders at the center joint using a block and sandpaper, not a

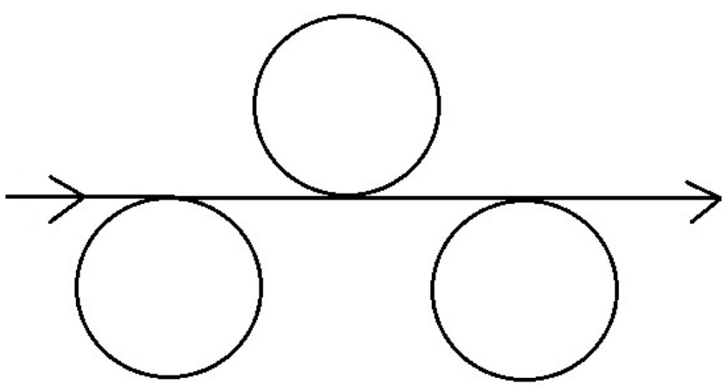
belt sander. Usually a few strokes with the sanding block make it easier to get into position.

FRET BENDING JIG

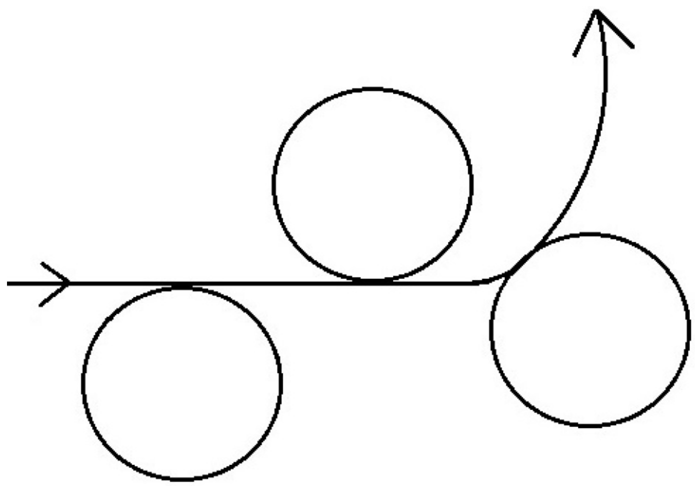
Fret wire needs to be bent into a even curve prior to being driven into the fretboard. This can be done by hand, which is time consuming and fairly inaccurate, or with a jig. There are several jigs available online that can be used, but it is much less expensive to make one.



A fret bending jig uses three wheels and a crank to pull flat pieces of fret wire through, and make them curved. The way the wheels are positioned on the jig is what determines how tight of a curve will be made in the wire. This can be adjusted quickly should the need arise, though normally it will be left on the same setting for a very long time.



The way the jig works revolves around the three wheels. The diagram above shows three wheels that are all touching the same line through the center with their edges. The line represents a piece of fret wire, and the arrows are showing the direction it is being fed into the jig. When it contacts the wheels, the wire is not bent, because they are all on the same linear plane together. However, by adjusting the position of the right hand wheel, that can easily be changed.

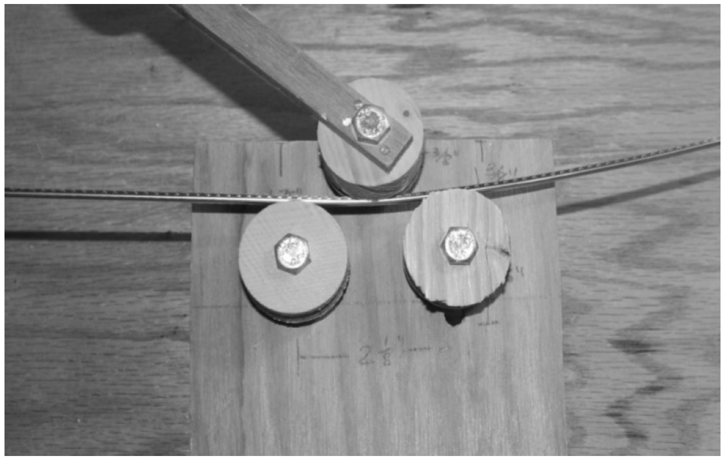


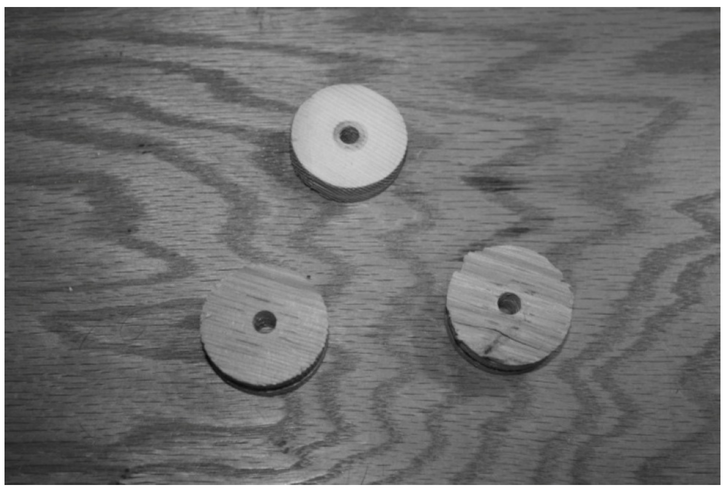
When the right hand wheel is moved upwards a little bit, it changes the direction of the line going through the middle. As the wire is fed from left to right, it contacts the first and second wheels with no problem. When it hits the third wheel, the wire is forced upwards. This upward force causes the wire to bend into a nice and even curve.

If the right hand wheel were moved higher, it would result in a tighter curve being bent into the fret wire, and likewise moving it down would reduce the tightness of the curve.

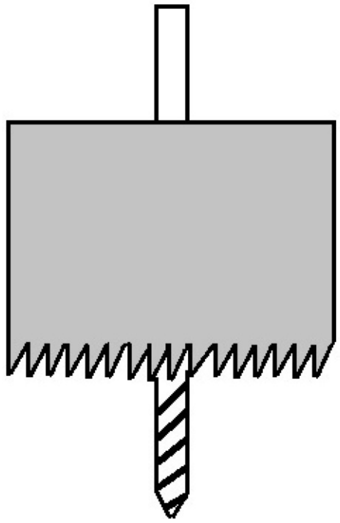
The fret bending jig takes advantage of the fact that the straight line has to bend when entering the third wheel, thus creating a curve.

Making a fret bender should be very clear now that the functioning of the jig has been explained, and it can easily be made from pieces of scrap around the shop. The store bought benders will be made from metal, which is far stronger than wood. However, a well made wooden fret bending jig will last decades in the shop.





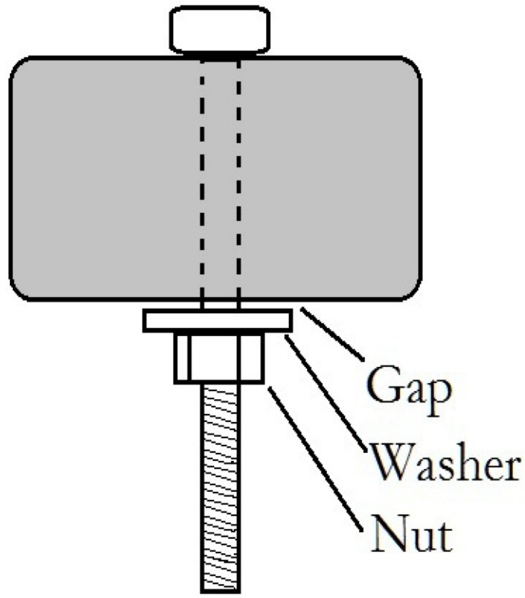
The first items that need to be made are the three wheels that make up the main functioning parts of the jig. These can be easily made by using a hole saw with a diameter of 1-1/4" to 2", and a center drill.



A hole saw is a circular cutter with a drill running through the center. The top end is chucked into a hand drill or drill press, and it is used to cut small circles out of wood. This tool is handy in this case because it also leaves a center hole, which all the wheels need. Cut these from 3/4" scrap wood, MDF or plywood being the best because the sides are softer than regular wood, which will allow the fret wire to wear a groove in each wheel. Four of them will need to be cut to make the jig, three wheels that bend the fret wire and one for the handle on the hand crank.

The round wheels can be cut using other methods like a lathe or carefully cut by hand using a saw. The wheels will need to be as close to perfectly round as possible, which makes the few dollar investment in a circle cutter well worth it.

After the wheels are cut, they will need to have their hardware installed, which will allow them to function as they need to in the jig. The center holes will need to be enlarged possibly to accommodate the bolts being used. 1/4-20 bolts are used on this project, and need a center hole a little larger than 1/4" in diameter.



The hardware needed for two of the three wheels is a 3" long bolt, a washer, and a nut. Make two of the wheels look like the above diagram, making sure to leave a very small gap about the size of two playing cards between the wheel and the washer.

The two wheels should now look like the above picture, ready to be installed in the main board once it comes to that step. The wheels will

not have the grooves seen in the picture yet, because that step will come later on in the project.

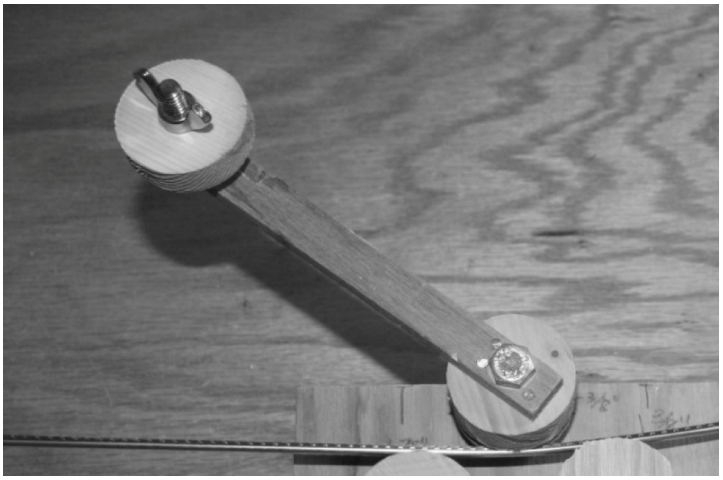
The next few steps will involve making the center wheel and the crank that will be used to turn the fret wire through the jig.

The center wheel and crank are shown in the above picture, with the wheel that is held in the hand while cranking removed. The wheel on the right is the center wheel in the final jig, and it needs to be attached to a small length of wood with a few nails or some glue.

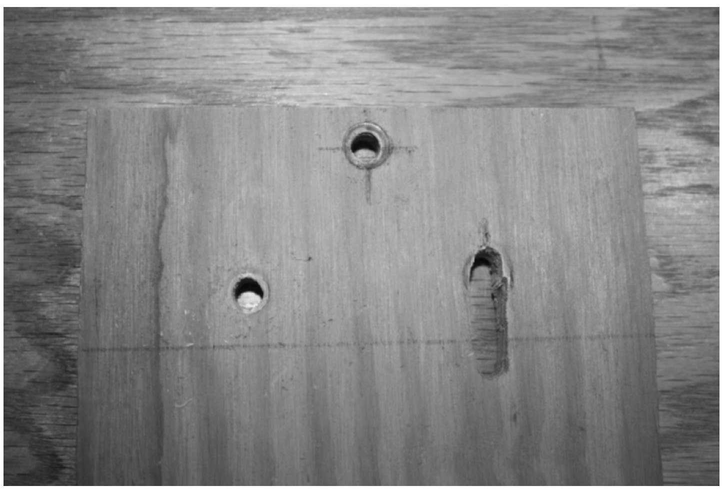
The center wheel needs to be locked into position against the crank arm because it needs to turn only when the crank is rotated. This will attach to the main board the same way the other wheels do in the end, with a single bolt, a washer, and a nut.

Cut a small piece of wood for the crank, about 6" long and 1/2" - 3/4" wide. The thickness does not matter, though a piece about 1/4" thick will work well for the purpose. Drill a matching hole through the end of the arm for the bolt, and center it over the hole in the wheel. Glue this in place, using a couple small nails to hold it, while the rest of the crank is worked on.

At the other end, the left end in the above picture, insert a bolt from the same side as the wheel is on, then add a washer and finally a nut to hold it in place.

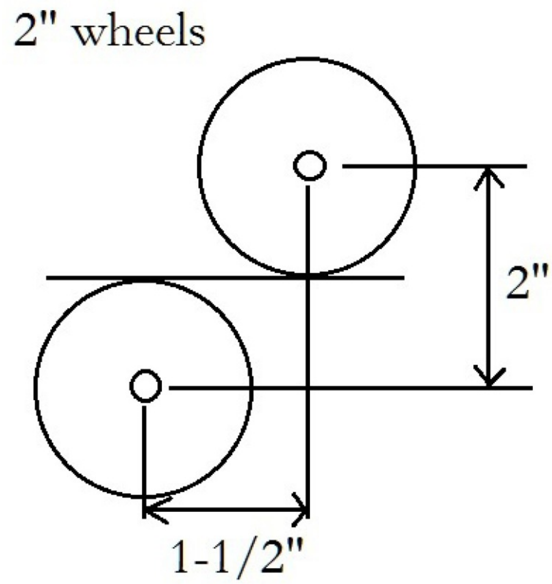


On the left side of the crank, place the fourth wheel, which is the part held in the hand while cranking. Screw on a wing nut or regular nut, but do not screw it tightly. The hand crank wheel must rotate freely in the hand while operating the jig, so snug the nut in place but do not tighten it down.



Now that the crank and the two other wheels have been made, the board that they will all be bolted to can be made. This is just a piece of half inch thick plywood, though any scrap will work. It only has to be wide enough to hold the three wheels, and long enough to be clamped into a vise if desired. A piece of plywood that measures 12" long and 6" wide is a good size to work with for the board.

Drill the first hole so the 1/4-20 bolt just goes through it without needing to be turned with a wrench. It should slide in and out freely, but not wobble. One drill size larger than the bolt being used is usually prefect. This hole will need to be drilled in the center of the board from left to right, and about 3/4" from the top.

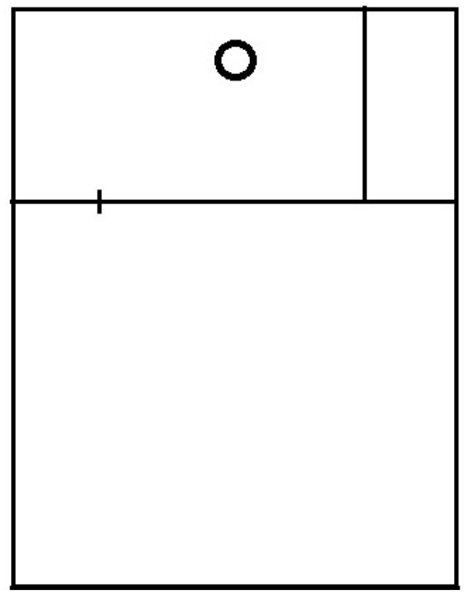


The placement of the two side wheels will be based on their size, as smaller wheels will have a closer placement. The above diagram is based on two inch wheels, though it can be adapted for any size by using the same ratios.

The left hand wheel must be the same distance from center to center as the diameter of the wheels being used. In this case, the distance from center to center is 2". Once the distance up and down is determined, make a horizontal mark across the board, because both of the side wheels will need this mark.

Next, the distance left to right will need to be determined. The wheel needs to be 1-1/2 times the radius to the left of the center wheel from center to center. In the diagram on the previous page with 2" wheels, this means a distance of 1-1/2" to the left. Measure from the center hole 1-1/2" left and make a mark on the already existing horizontal line.

On the right side, measure out the same distance and draw a vertical line from the same place, all the way to the top.



The board should now look something like the above diagram, with a horizontal line drawn across the piece that is the same distance from the center hole as the diameter of the wheels, a mark on the left hand side that is 1-1/2 times the radius in distance from the center hole, and a vertical line on the other side also 1-1/2 times the radius from the center hole.

With the layout completed, the holes must now be drilled for the side wheels. Drill a single hole on the left where the two marks cross that is the same size as the center hole.

On the right drill a hole in the same place, and another one that is 1-1/2" up and on the same line. These two holes will need to have the joining wood between them cut out with a jig saw, scroll saw, or by hand with a coping saw. Alternatively, several holes can be drilled between the two main holes, and the rest can be removed with a chisel. This will form the slot that the right hand wheel will be adjusted with.

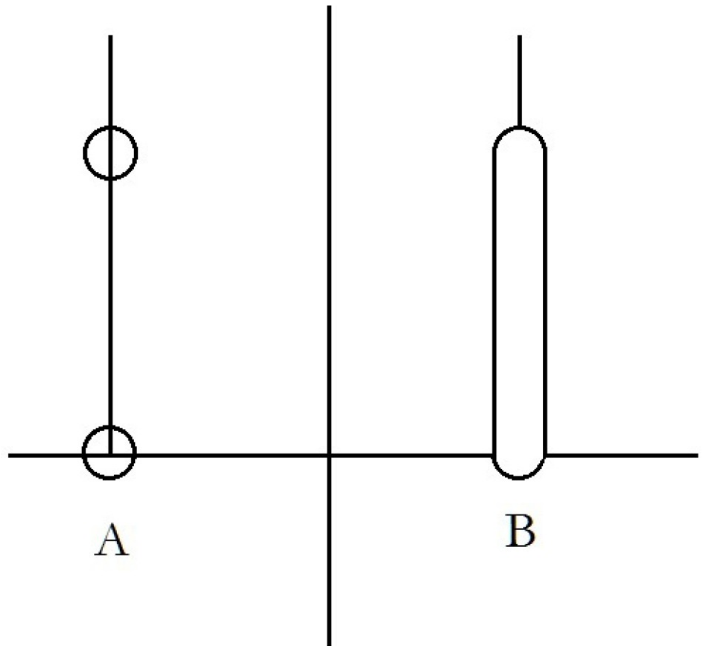
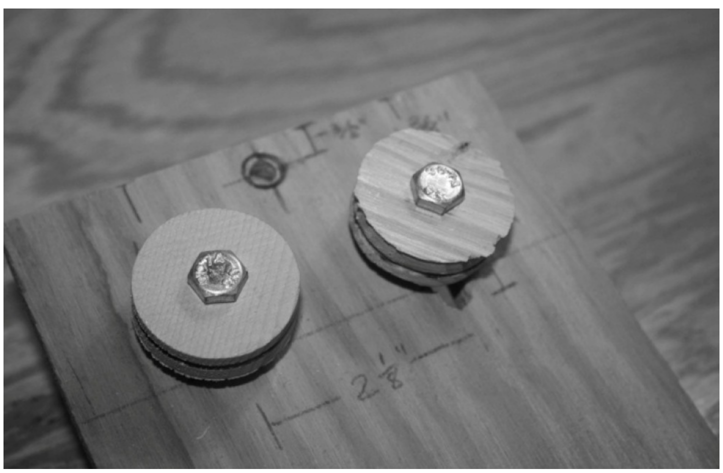


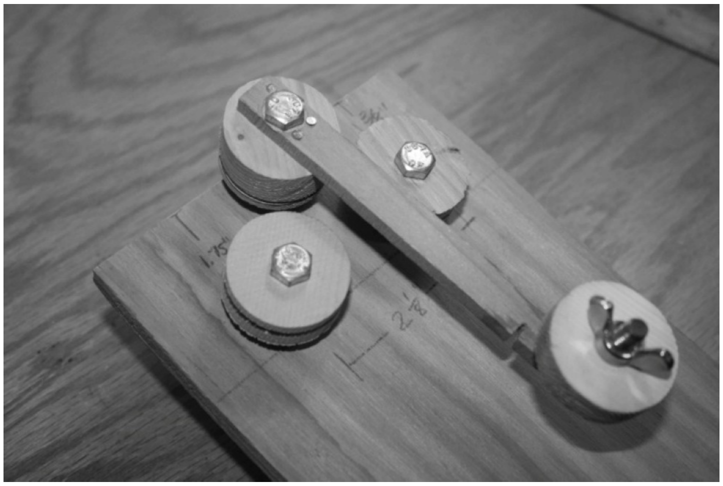
Diagram A above shows the two holes drilled into the board, one on the intersection and one above it. Diagram B shows the space between those two holes cleared out with a saw. This is done so the right hand wheel can move up and down, adjusting the radius of the fret wire exiting the jig.



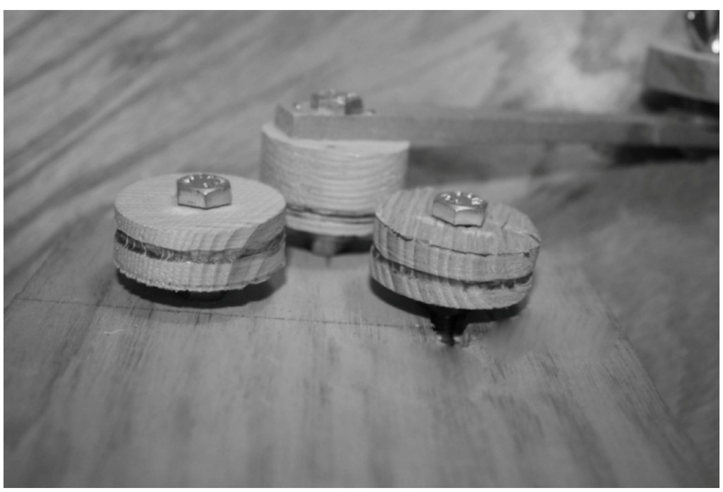
With the board completed, the assembly phase can begin. Start by attaching left and right wheels to the board. Insert the bolts through the holes, tightening a nut on the back of each of them to hold them in place. A regular nut is best for the wheel on the left, since it will not need to be

adjusted. Tighten this nut down with a wrench, but make sure the wheel still spins.

The wheel on the right should be attached in the middle of the slot, using a wing nut on the back which will make adjustment easier.



Finally, attach the crank by inserting the bolt through the hole, and securing it with a nut on the rear side. This nut can also be tightened down well using a wrench, but again make sure the crank can still spin after this is done.

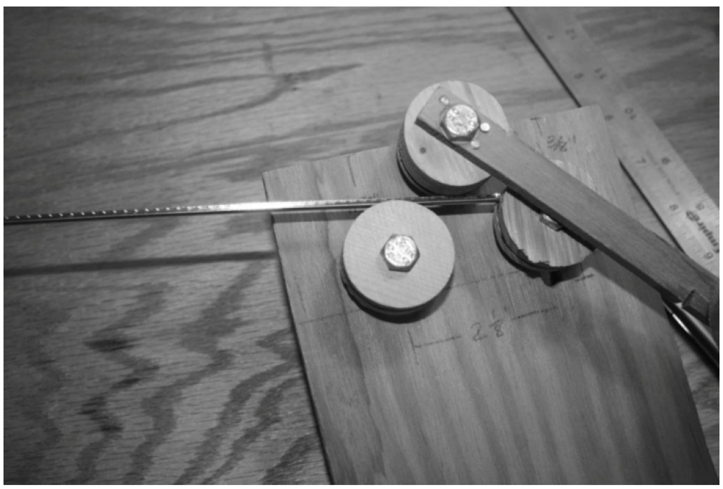


To get the grooves in place that will help keep the fret wire in the right place on the wheels, simply run a piece of fret wire through the jig from left to right, with the tang facing up. The first time this is done, it will

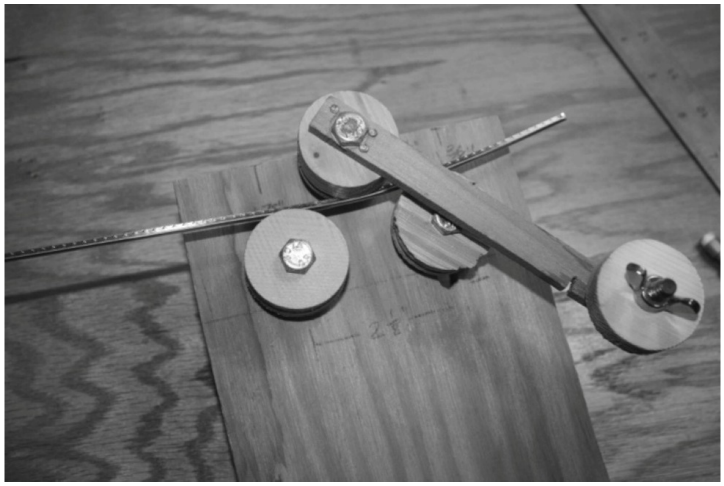
take some effort to keep the fret wire in the middle of each wheel, but it will become easier with each pass through the jig.

Straighten the bent fret wire by hand, and send it through again. Repeat this process several times until a small groove has been worked into each wheel on the jig. Make sure to always insert the wire with the fret tang facing up, and always in the same position on the wheel.

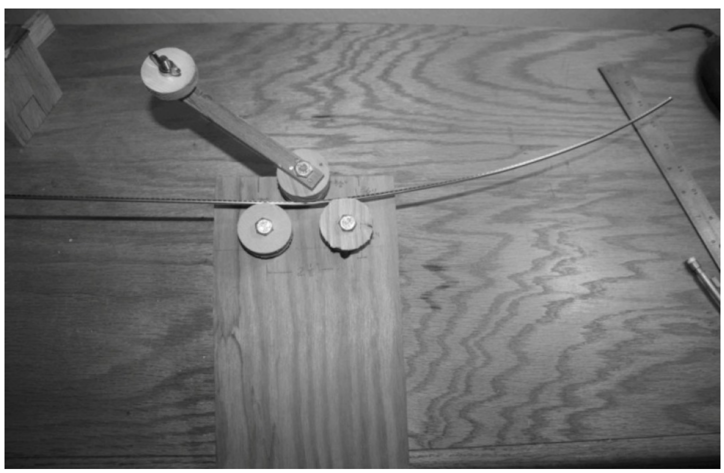
If the jig needs to be adjusted, loosen the wing nut on the back of the right hand wheel, and raise it up to tighten the curve. If less of a curve is desired, lower the wheel a little bit, and run the fret wire through. A piece of fret wire can be ran through the jig several times until the right radius is found, and more fret wire can be run through after that.



Once the bender has been set up to the correct radius, use it by inserting a piece of fret wire from the left hand side with the tang facing up. Begin turning the crank counter clockwise as the wire is drawn into the jig.



The bend that the wire takes will immediately be seen as the piece is exiting the bending jig, and the once straight wire takes a radius.



Continue cranking until the fret wire comes out of the jig, making a perfectly bent radius. Repeat with as many pieces of fret wire are needed.

FRET SETTING CAUL

A useful item to have around the shop when it comes to fret work is a fret setting caul. The standard way to put frets on a guitar has long been the hammer, but this method has its drawbacks. First of all, a hammer is not exactly a precision tool. One wayward blow and there will be a large dent in the fretboard that will need to be either steamed or sanded out. Neither of which is easy once frets are in the way. Plus, if the damaged area has to be sanded too much, it will show as a dimple when viewed at an angle.

Second, the hammer puts all the force in one small place on the fret, which can sometimes cause one end of the wire to pop out of the board, taking little splinters with it. After this happens the fret never really goes back into the slot with the same hold ever again, and it just becomes frustrating to wonder if a fret is going to pop loose at some future date. The splinters will need replacing and gluing, which will require more sanding, which can lead to the problems already mentioned.

The best way to seat a fret is to seat the entire thing at the same time, with nice and even pressure along the entire length of the wire. Taking the idea from a fret press, a small wooden caul can be made to the same

radius as the board being fretted. This caul can then be used with a hammer to evenly seat frets, without any of the problems that are associated with hammering.

The best wood for the fret setting caul is a hard wood that is not too susceptible to cracking, and has a little elasticity to it. I have been using Goncalo Alves for a long time and it works very well. Purple Heart does a nice job, and so does Maple. This piece will be hit with a hammer over and over so it has to be a nice piece without cracks or defects that might cause it to fall apart during use.

Once the wood is selected, cut a piece that is 2-1/2” inches long, 4/4 wide, and 2” tall. The grain should run along the length if possible. Using a ruler and a pencil, mark an arc on the bottom of the piece that matches the radius of the fretboard being fretted. This will give a close approximation of the radius, so the bulk of the waste material can be cut off.

To do this, simply pivot the ruler from one side with the pencil on the other end the correct distance away. For a 16" radius, hold the pencil at the 16" mark on the ruler, and as the ruler pivots along its arc, the curved line drawn will be a segment of a circle with a 16" radius. The same can be done with a piece of string, a tack, and a pencil. Tack one end of the string down to the workbench, and tie the other end to the pencil right around where it is gripped for writing. Wrap the string around the pencil until the length is 16", and when the pencil is used to draw an arc, it will have the same radius.

Cut outside the line as close as possible with the band saw or jig saw to remove the waste material. The edge will now be refined with sandpaper to a perfect matching radius.

Take the fretboard that is going to be fretted (presumably it already has a radius) and lay a piece of 80 grit sandpaper over the top of it. Tape the ends underneath pulling the paper tightly so there are no gaps, and the paper is clinging tightly to the board.

Work the fret setting caul back and forth along the sandpaper, keeping it perpendicular to the fretboard and square the whole time. This will take a few minutes but the sanding will remove the jagged edges left from the saw, and transfer the radius that is on the fretboard right to the caul. Check the piece from time to time to make sure there are not any problems developing, and adjust the caul to get the edges as well as the center nice and smooth.

Once the fret caul is nicely smoothed out, it is ready to be used to install frets. It will take a few fret installs for the caul to develop a small indent along the middle where the fret repeatedly strikes the caul. This will help in the future as the caul will locate itself in the dimple and make fretting easier each time it is used.

To use the caul, cut a length of bent fret wire that overhangs the fret slot a little bit on each side. Tap the ends lightly into the edges of the fretboard to stick it in place, and help the caul do its job. Then, place the caul over the fret, centering it as best as possible. Strike the caul with several hard hammer blows, and listen and feel for when the fret has been seated. The hammer sound will change as well as the feeling of the hit once the fret has gone as far as it can. Remove the caul and check for gaps, re-setting if necessary, and move onto the next fret.

Since this is a wooden item, there will come a time when it will crack or split, and will need to be replaced. This should take several fretboards worth of fretting before it is needed, but again, it is still only a wooden tool. If this looks like a method that will be used for a long time, take a few extra minutes and make a second caul while making the first. This way, it can be saved and brought out when needed.

If the fret caul needs replacing, it will inevitably need it right in the middle of a fret job. If a second caul is already in the shop, it is a simple matter of grabbing the new caul and finishing the current fretboard.

Lastly, some species of wood will work far better than others for the fret setting caul, and as a rule, the denser woods are better. The fret setting caul in this example is made from Goncalo Alves, and has done at least a dozen fretboards without any problems at all. There is a small dent in the center, but it is not so deep yet that it does not do a good enough job of setting the frets. Choose a species with a similar or higher density than Goncalo Alves, like Zebrawood, Brazilian Cherry, or Purple Heart. This way the caul will last a long time, and be an great part of the shop process.

Project Notes:

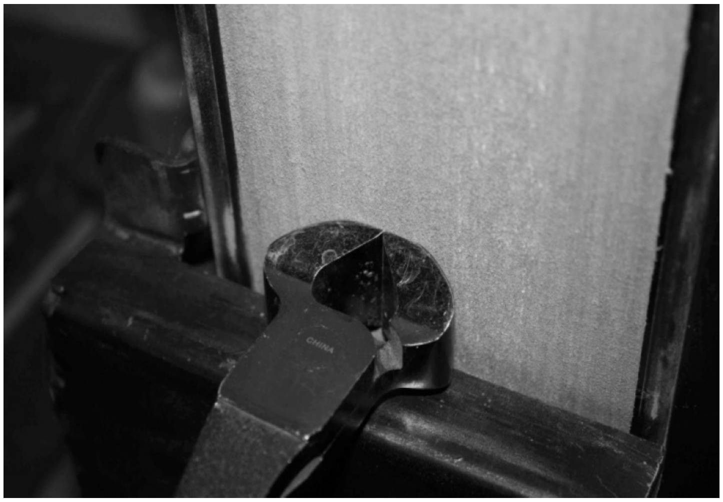
The fret setting caul works the best when the fretboard is separate from the neck. This allows more freedom to use the hammer without fear of knocking anything loose or breaking through a guitar top. The entire fretboard can be finished apart from the neck and then joined back together for final shaping. Also, hammering against a solid surface will mean that more of the force is transferred into the fret. A wobbly work bench is not a good place to hammer frets. If a good solid bench is not available, a concrete floor like in a garage or back porch works really well. It is much easier to hammer frets on the garage floor than anywhere else in the shop actually.

Every fret job ever done in my shop has been done on the floor. It is so much harder than the workbench, and it does not give at all when hammering. The frets seat quickly, cleanly, and they do not come out. Sweep a small spot on the concrete and try hammering in a few frets, it will definitely be worth getting on the floor.

FRET NIPPER PLIERS

A handy tool to have around the shop is a pair of specially ground fret nipper pliers. These are a set of heavy duty wire cutters that have been ground close to the cutting surface. This allows them to be placed right up against the fretboard to trim the fret overhang. The benefit of cutting the fret wire closer is there will be less filing to be done to bring the fret ends flush with the fretboard.

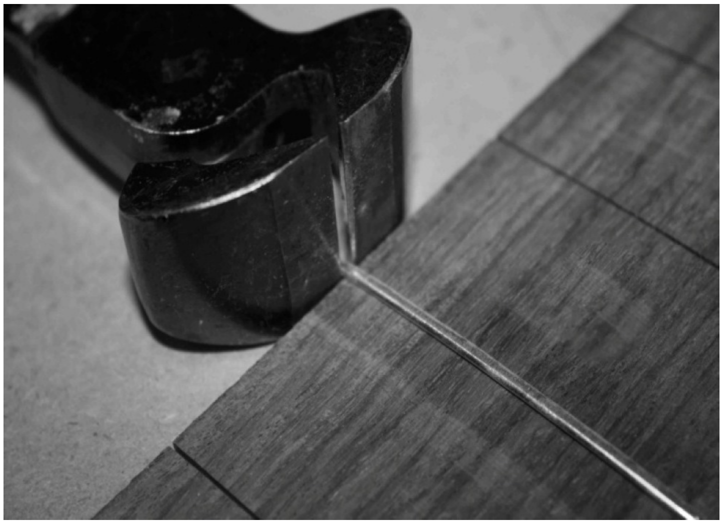
To start, pick out a set of cutters to turn into a set of fret end nippers. They should have large flat faces like the cutter in the picture above, and be large enough that pressure from one hand can cut a fret wire. This is important because if they are small and require both hands, the chances of twisting a fret wire increase the more the pliers must be wrestled with.



A belt sander with a good quality belt is actually far easier to use than a grinder for this tool modification, because the surface is much larger. A grinding wheel has a smaller area, and it can be hard for a person who does not work with the grinding wheel to get the faces even. The belt sander will remove material from the whole face at one time, which makes it far easier to get everything clean looking. The point is to remove the extra material from the face of the tool, getting the cutting edge as close to the face as possible.

Hold the face of the cutters against the belt sander with a 120 grit belt for a couple seconds, then pull it away. Allow it to cool for 30 seconds, then repeat the process again. The point of removing the tool often is to keep it from getting so hot that the steel loses its temper, making it not

a very good cutter after a while. This will take some time, but remove enough steel that the cutting edge is very close to the face of the tool. Get as close as possible without grinding through the cutting edge, which can be seen by the small indent along the face of the cutter in the above picture.



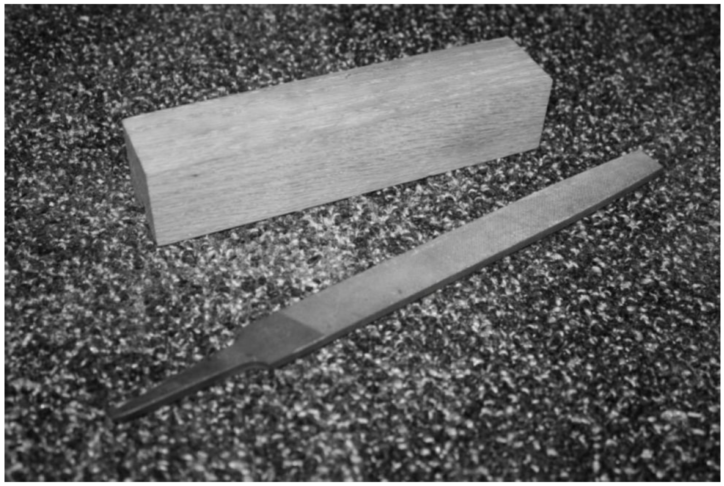
The picture above shows how close the fret cutter can now get to the fretboard, which means it can remove almost all the fret overhang. This means cleaner fret ends, and less work to file off and level out the edges later in the process. The nipper can still be used for other cutting applications since the jaws are still very strong, it just makes a much better fret end nipper now.

FRET BEVELING FILE

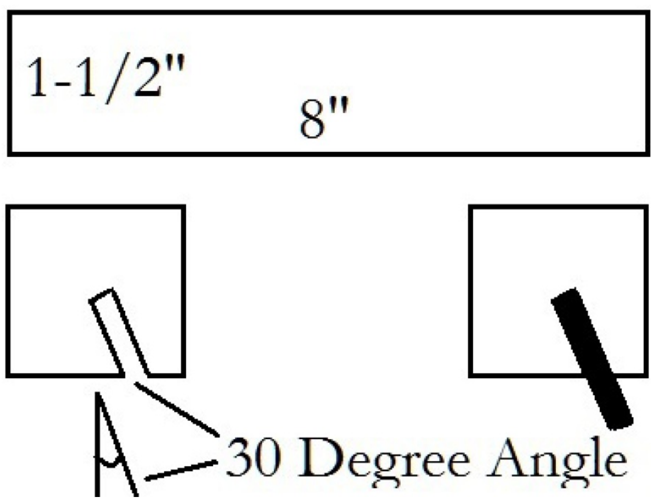
After the frets have been installed and the ends filed flush with the fretboard, they will need to be beveled. This takes place on each end of the fret, and it makes them easier to slide the fingers over, as well as making them look nicer. The fret ends are typically beveled around 30 degrees to the surface of the fretboard, which does not remove much of the playable area from them.

This kind of beveling can be done entirely by hand if desired, however the process can be made much easier and more uniform by making a holder for the file. This special block will hold the file at a known angle, 30 degrees, and ensure that all the fret ends have the exact same bevel to them.

The tool can be made permanent by sawing off the file tang and heel, and using epoxy to secure it to the block. Or, as in this case, the file can be left removable so it can still be used for other things.



In order to make the tool, a piece of 1-1/2" square scrap wood that is around 8" long will be needed. The exact measurements for this do not matter really, as long as the piece is long enough to hold the entire file, and at least 1-1/2" square on the ends. It will only need to hold the file and serve as a guide that can be slid along the tops of the frets while the file does the work on their edges.



The way the handle block will need to be made is shown in the diagram above, and is really just a piece of wood with a 30 degree cut made into the bottom. This cut allows the file to be inserted into the opening with a pressure fit, and then it can be removed later for other uses.

To make the cut at the proper angle, a table saw with a tilting blade is needed, which makes it easy to dial in the proper angle. Set the table saw blade to 30 degrees, and measure it with an angle gauge to make sure it is correct. If it is off by a fraction of a degree that is fine, but if it is off several degrees make an adjustment and measure again.

Once the blade has been set, lower it to a position that is an inch over the table top, and make a test cut on a piece of scrap. The blade should be lowered enough that it only goes about half way through the scrap, which will protect the fingers during this process. Measure the resulting cut to be sure it is very close to 30 degrees, and then the saw is ready to make the real cut.

Make the first cut as seen in the diagram on the previous page by setting the fence so the entrance point of the blade is 1/4" from the lower edge of the wood. This will leave the majority of the bottom face undisturbed and will function as a guide that runs along the tops of the frets. Make this first cut with a standard saw blade, and make it deep enough that at least half the file could be pressed into it.

A second cut will need to be made after the first one, which will widen the slot a little more, and allow the file to fit. Depending on the kerf of the saw and the thickness of the file, one or more secondary cuts will be needed to widen the slot.

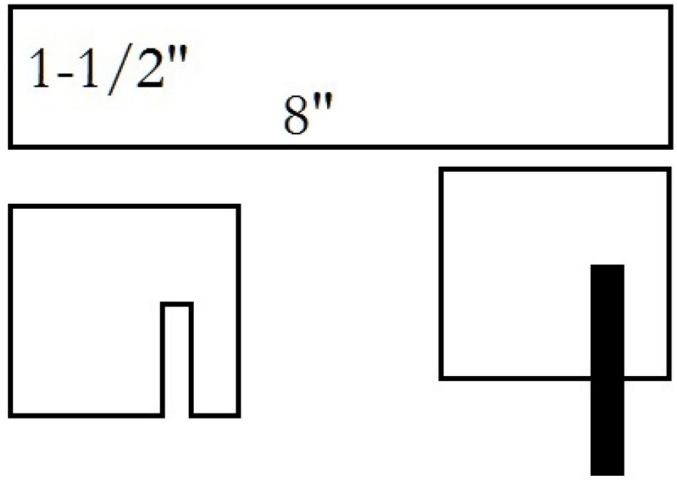
Adjust the fence away from the blade a tiny fraction, and then make another cut. Test fit the file and determine if more cutting is needed. Always take a smaller cut than predicted, because wood can always be removed with more cutting, but it can never be put back. Once the file fits snugly into the slot, the sawing is complete.

Test fit the file into the slot, making sure that it is a nice and snug fit and that the file does not fall out easily. If making this tool as a

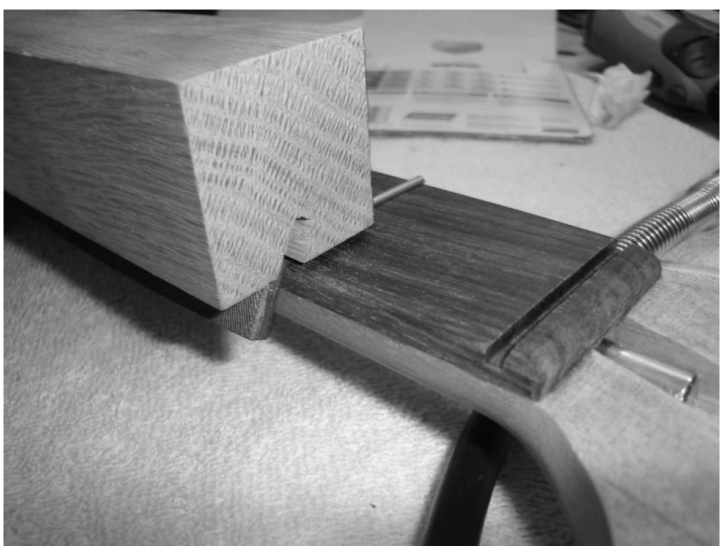
permanent fixture, make the slot so that the file can be placed inside and removed easily, without any resistance. This will ensure there is room for the epoxy, which will make the tool permanent.

If using a pressure fit, insert the file into the slot, and give it a couple bumps with a rubber mallet to make sure it holds well. If using epoxy, trim off the tang and heel as described in this chapter for the Hand Held Fret Leveling File, and epoxy it in place.

Before the fret ends can be beveled, they need to be filed flush to the ends of the fretboard, as in the picture above. This can be done with a similar tool, but with the cut made vertically instead of angled, or it can be done with a sander or by hand.

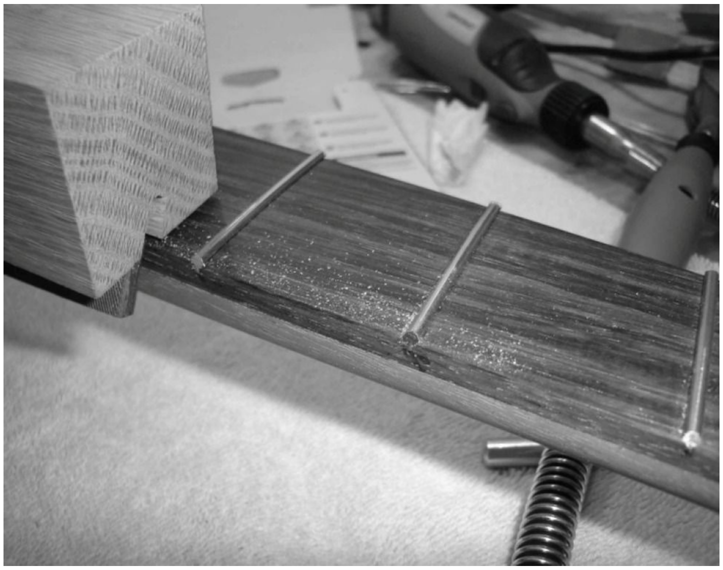


If making a file holder that will make the ends of the frets flush to the fretboard, follow the directions from the beveling block, but do not tilt the table saw blade. This will make a vertical opening that the file will reside in, and when slid along the edges of the frets, it will make them flush. This is a much easier and cleaner way of flattening the edges than doing it by hand.



Place the block on the fretboard as seen in the picture above. The flat underside should ride along the frets nicely, and the file should hang over the edge, ready to begin the beveling process. At first, go very slowly, and do not file aggressively. The file will need to remove some

metal from each fret end in order to even them out before it can really take off any serious metal. This will generate heat as well, so make sure to stop from time to time and check that there is not too much heat being built up.



Follow along one edge of the fretboard until all the ends have been beveled, which will take several minutes. Continue filing only until the frets are fully beveled, and the file just begins to make contact with the edge of the fretboard. This is as far as the fret can be beveled without taking off too much of the fretboard, so stop once the wood is touched.

Switch to the other side and do the same thing to the other fret ends, beveling them completely down to the edge of the fretboard. Inspect the job after it has been completed, and verify that each fret is perfectly beveled.

Once the ends have been beveled on the file, they will need to be rounded slightly with sandpaper, because the edges will be sharp after filing. This is also a good time to knock down the sharp corners of the fretboard. Round them over just barely, only to remove the sharp edge. Switch to the other side and do the same thing using 220 grit paper, and finger pressure to do the work.

Once the ends have been sanded, the fretboard will look something like the one in the picture above. The bevels will be even, the edges rounded slightly, and the whole fretboard will have a nice look to it.

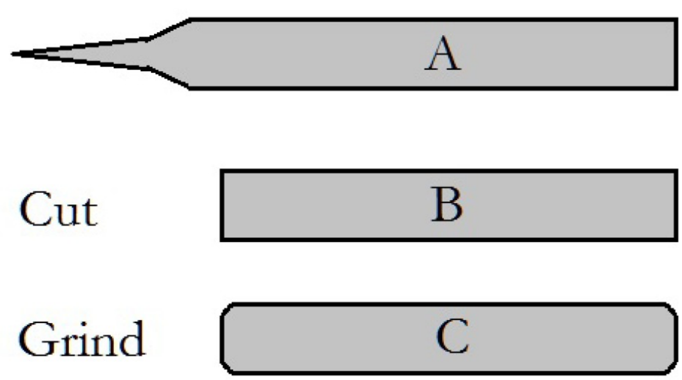
If this sounds like a great way to flatten and bevel the ends of the frets in the shop on a permanent basis, make these tools permanent by altering the files and using epoxy to keep them in place. The tool will function the same, however it will not have to be searched for and assembled each time a fretboard needs to be worked on. Having the tools in one piece, and stored in drawer or hung from a peg board will place them within easy reach. The cost of materials is really just the files, since the wood can be scrap.

HAND HELD FRET LEVELING FILE

When leveling out the frets after they have been seated and the ends trimmed, a large file is a very useful tool. It is also much easier if the file is attached to a piece of wood, which makes the whole process smoother, because the file is easier to hold on to.

The following fret leveling file is very easy to make, and will require a flat metal file that could be used in fret leveling. Also, a block of wood big enough to make a handle from, and some epoxy to hold it all together will be needed. The wood will need to be at least as long as the file, and as wide. A height of a couple inches will work just fine, as the block is only to aid in gripping the tool.

Check the file before using it to make sure that it is completely flat on the faces, which is important because it will be used to flatten the newly installed frets. In order to be able to effectively flatten and level frets, the file itself needs to be flat.

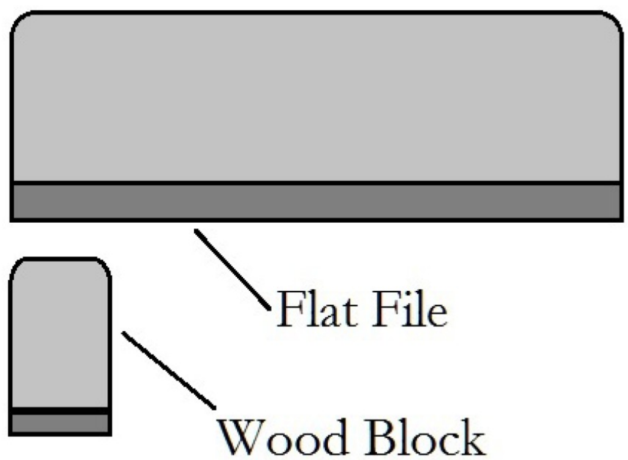


The first step is to take the file and remove the tang as well as the rest of the lower area where there are no cutting grooves, called the heel. This can be done in a number of ways, however since metal files are made from hardened steel, it is not as easy of a process as it looks.

Typically, a hack saw will have trouble going through the metal with any kind of speed, and may destroy a blade in the process. It will go through eventually though, and can be used for this process.

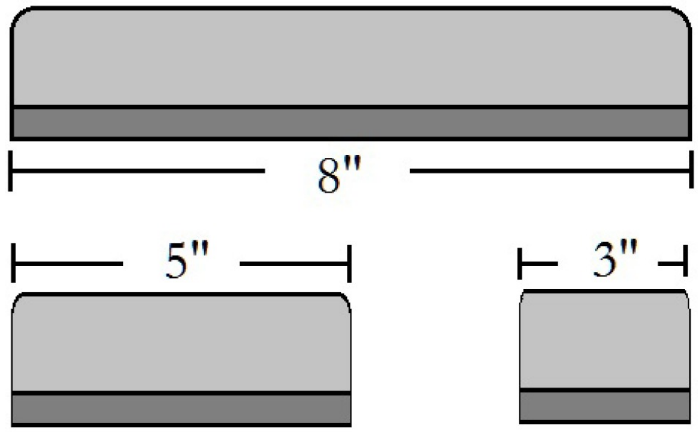
A metal cutting saw, with an abrasive disc for a blade is the best way to ensure a very clean and straight cut, and anyone who works with metal will have one of these in their shop. Ask around and perhaps someone close by will make the cuts, which will take far less time.

Once the tang and heel have been removed, and the file is nothing but cutting grooves, the corners will need to be rounded over slightly, in order to remove the sharpness and reduce the chances of digging into the fretboard on accident. This can be done on a grinder, and does not have to be as dramatic as the earlier diagram. A simple removal of the sharp corners will be perfect.



The next step is to cut a piece of scrap to use as a handle, which will be the same width and length as the file, and a couple inches tall. The height does not really matter, and anything around 2" will be comfortable. If a more elaborate hand grip is desired, leave enough room to sculpt it once the pieces have been glued together.

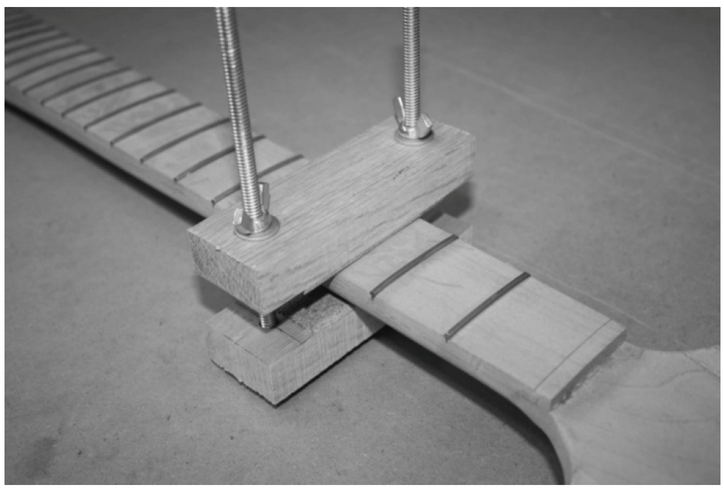
When the wood has been cut and shaped, glue the tool together with a 2 part epoxy, coating as much of the file face as possible, before clamping it tightly to cure overnight. Clean any drips immediately, and the file will be ready for use in the morning. Coat the wood with boiled linseed oil or Tru-Oil for a nice looking handle.



Several different sizes of fret leveling file can be made for use in the shop, saving money over buying them. A few useful sizes are shown above, and can be made from a pair of 10" flat metal files. Take the time to make these well, and they will be a part of the shop for a lifetime.

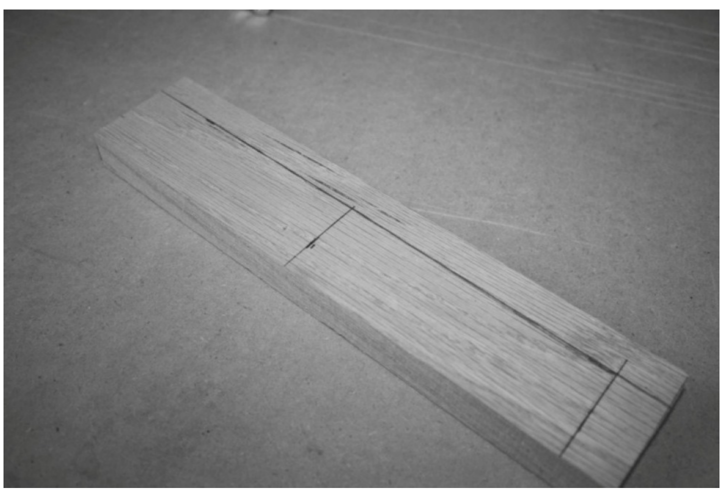
FRETBOARD GLUING CLAMP

When gluing the fretboard to the neck, many clamps are required in order to get a strong and level glue joint. Small bar clamps can be used for this purpose, however they are more valuable in other applications. A nice way to save the main clamps for other jobs and still clamp down the fretboard for gluing is to make a set of fretboard gluing clamps.

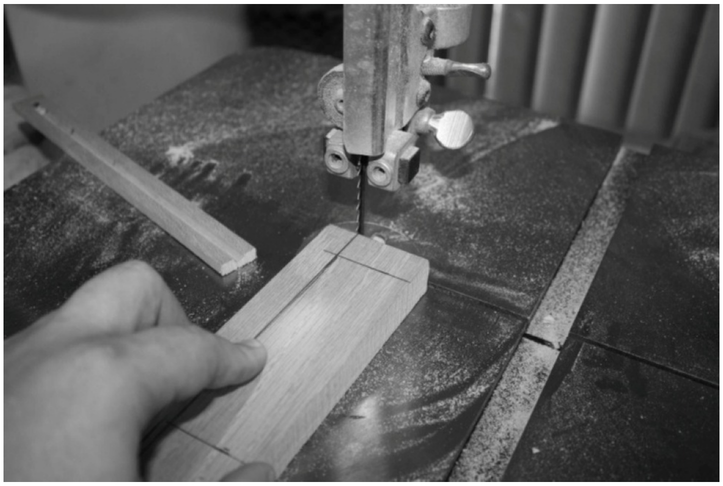


These clamps are made from scrap wood that is lined with cork to prevent dings and dents to the guitar wood, and held together with bolts and wing nuts. The clamps are slipped over the headstock or the top caul is removed completely, and then placed in position. The wing nuts are tightened down creating pressure between the two pieces, clamping the fretboard to the neck.

To construct the clamp, a set of hex bolts are required, each being 6" long. The reason they are this long is so they can be opened very large to pass over the headstock. A few washers and a pair of matching wing nuts are also needed, as well as a piece of scrap wood for making the cauls. A layer of cork will be glued to the faces of the clamp, which should be 1/8" thick, and is found in an office supply store.



Measure out on the scrap piece of wood a pair of rectangles that are 4-1/2" long and 1-1/2" wide, marking the lines darkly so they are easy to see. This length will leave enough on each side that the bolts are not too close to the edge, as well as not being too close to the neck and fretboard.

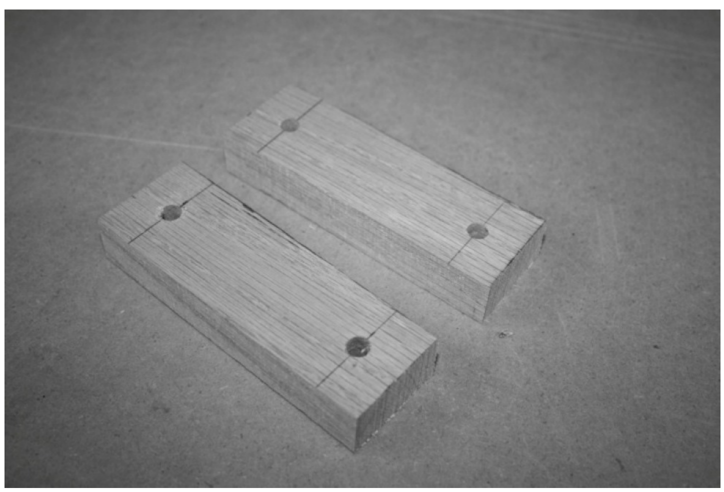


On the band saw or the table saw, cut out the shapes of the clamping cauls.

Once the two pieces have been cut out, measure in from each edge 5/8" and make a line from top to bottom. Find the center of this line which should be 3/4" and make a perpendicular mark on all four ends. The pieces should now look like the picture on the previous page, with all four ends marked for drilling.

Use an awl to make a depression where the marks intersect, which will help the drill bit make the hole more accurately. Instructions for making an awl in the shop are also found in this chapter.

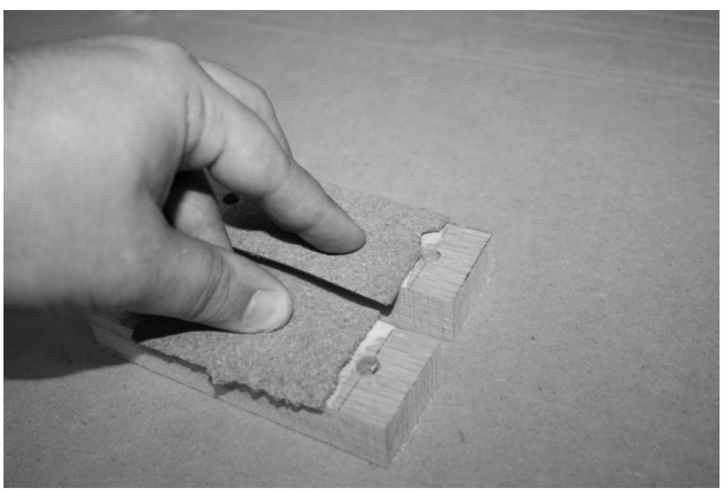
Using a brad point drill bit preferably, drill out the pieces following the marks and lines already made on the wood. If the two pieces are stacked and clamped together, both sets of holes can be drilled at the same time. They can also be drilled individually, as seen in the picture above.



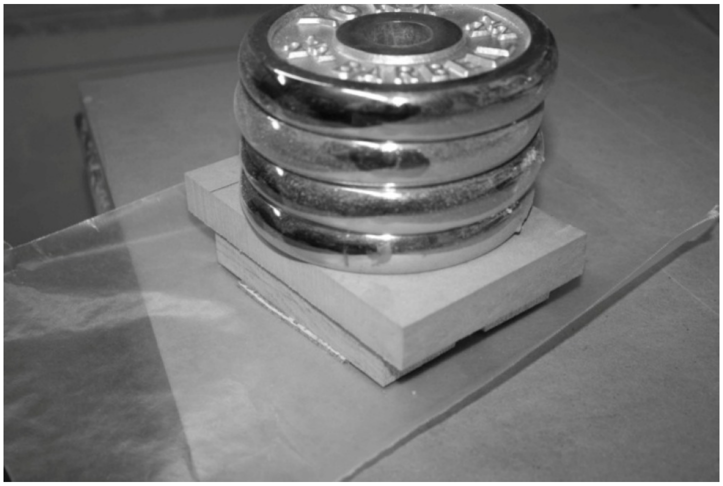
Now the pieces have been drilled and they are ready to be lined with cork, so they can be better clamping cauls. Before moving on to the gluing phase, line up the blocks on top of one another to ensure that the holes are also lined up well. This will be important to how the clamp functions, and will need to line up very closely in order to make a good clamp.

Next, cut two pieces of cork that are large enough to cover the spaces between the holes on the clamp faces. The piece should overhang the edges a little, and if they cover the holes they can always be drilled out later. The piece should be roughly 2" x 3-1/2", and two will be needed.

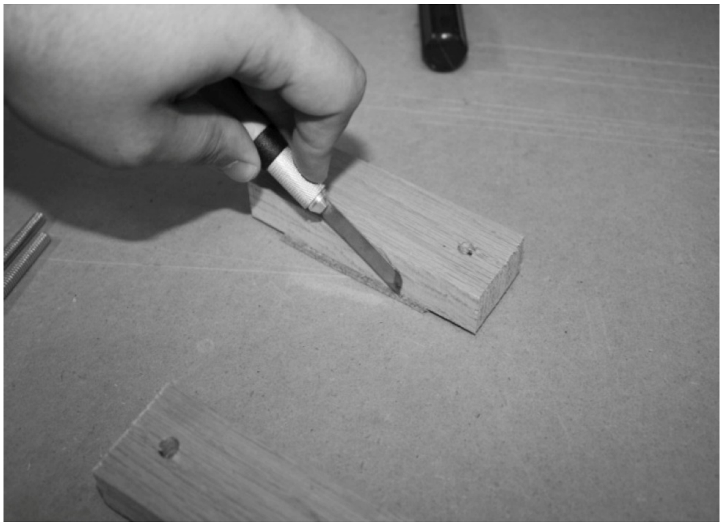
Cover the faces of the clamps with a layer of glue, and spread it out evenly over the surface.



Cover the glue with the cork pieces that were cut earlier, pressing them firmly.



Lay a piece of wax paper on the bench, followed by the clamping faces with the cork side down, a piece of wood to act as a gluing caul, and a few gym weights on top of it all. The piece of wood will help spread out the force from the weights, and keep the cork flat during gluing. A few small gym weights are all that is needed to keep the cork flat while it dries, which should be given a few hours. The wax paper will keep any glue that seeps through the cork from getting everything stuck to the bench, ruining the clamps.

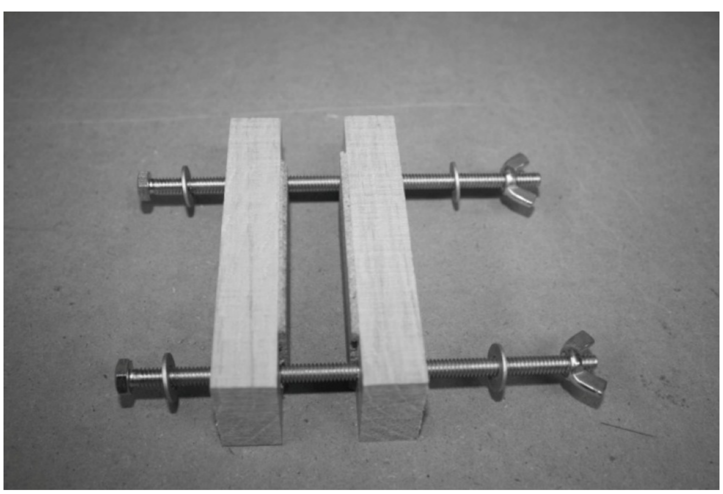


When the glue has dried, remove the weights, the caul, and the wax paper, and inspect the pieces. If the cork is smooth and glued well, cut the excess off with a razor knife, trimming as close to the edge as possible.

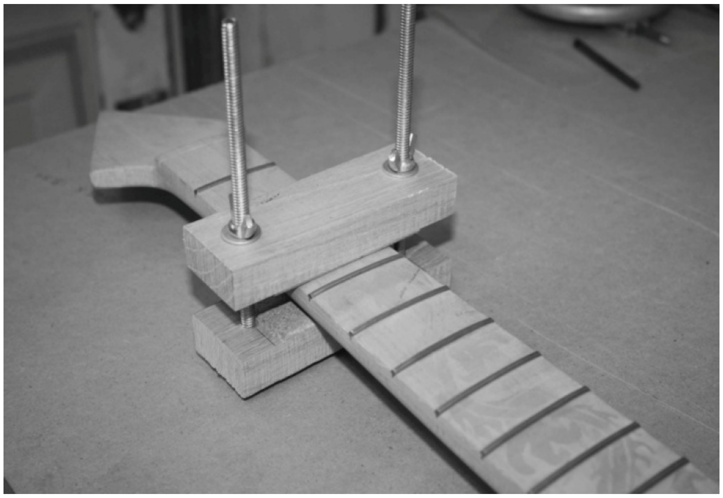
Do this on both pieces, being careful not to rip any cork off of the faces in the process, which can sometimes happen with a dull razor knife.

Bring the piece to the belt sander and carefully bevel the edges of the cork until they are nicely blended into the caul. Cork will sand quickly, so touch it lightly to the belt sander then look at it before touching it again.

While at the sander, take the time to break any sharp corners that the piece of wood may have, which will make the clamp more comfortable to hold while it is being used to glue the fretboard to the neck.



Assemble the piece as seen here, with the cauls facing each other, a washer on the top and bottom, and a wing nut at the very end. The washers are for distributing the force from the bolt head and the wing nut, and are important to have in place.



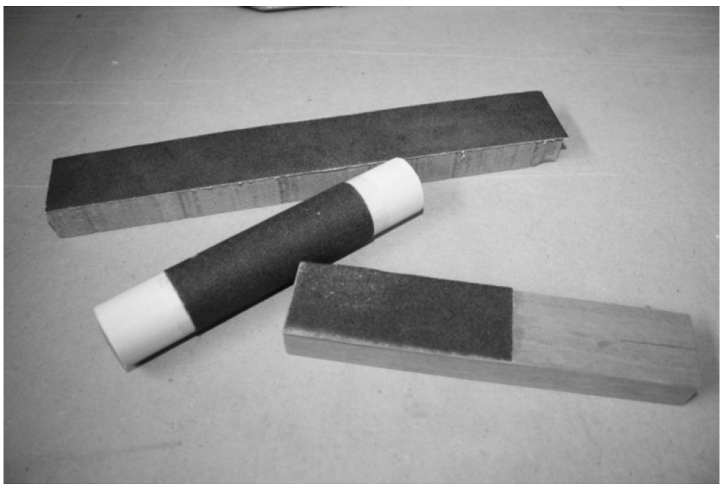
To use the clamp, open it up completely, and slip it over the headstock and into position. The fretboard and neck must already have the glue applied between them, and essentially be only waiting for clamps. Place it near the end where the higher frets are, and tighten the wing nuts to apply a little tension.

Next, place a second clamp a little bit above the first one, tightening it as well. They should be spaced apart a couple inches at the most, which will encourage good clamping pressure and good glue adhesion. It will take 6-8 clamps like this to fully lock down the fretboard, and it will be important to clean up any glue squeeze out with a wet rag, so it does not glue the clamps to the neck by mistake.

Using dedicated clamps for certain tasks is a great way to conserve the other standard clamps that are in the shop. They are easy to make, extremely inexpensive, and will do the job just as well as any other clamping method. Making several of these will only take a couple hours, most of which being spent waiting for the glue to dry.

SANDING STICKS

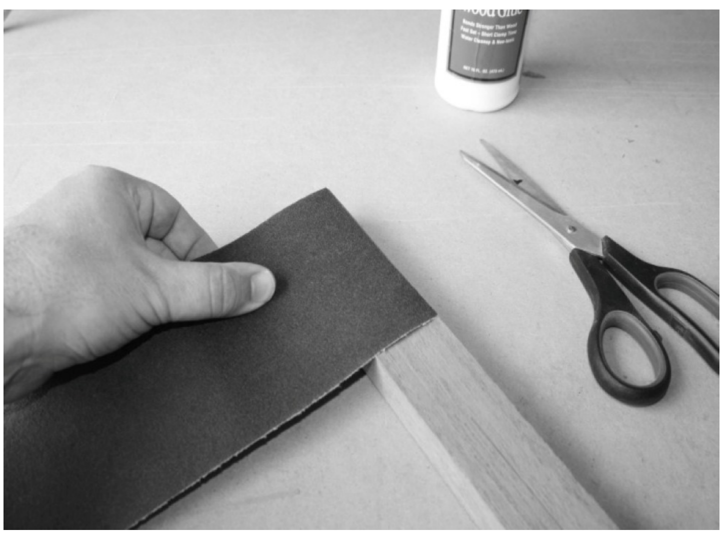
Many times, it is nice to have a set of sanding sticks that already have the sandpaper stuck to them, rather than making one each time they are needed. A sanding stick is just a piece of wood with a small section of sandpaper attached to it, which is used for touch ups as well as flattening hard to reach areas.



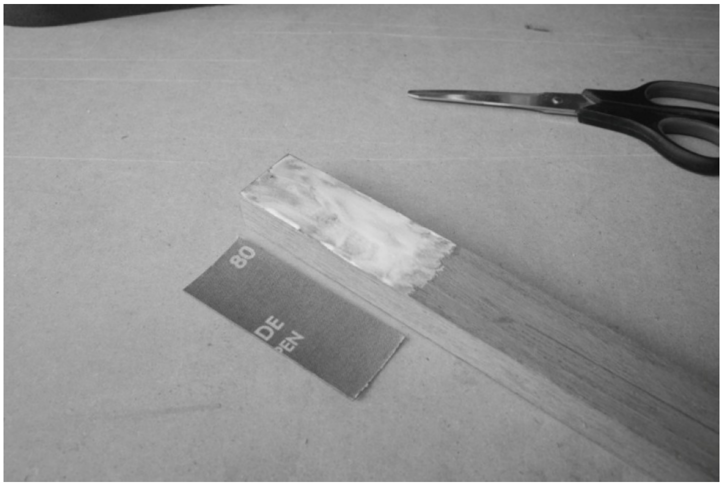
Sanding sticks can be made in a variety of different shapes and sizes to suit any application, and they are very easy to make. One of the best ways to make a long lasting and effective sanding stick is by using a belt sander belt as the sandpaper. This is a much longer lasting as well as tougher piece of sandpaper, and that is because it is not really paper at all.

Belt sanders typically use a type if cloth fiber backing instead of paper. This makes the grit last longer because it does not become separated as quickly with use. It also lasts longer just because it is designed for use with a belt sander rather than for use by hand.

A few different sanding sticks will be made in this example, all of which will be faced with 80 grit paper from a belt sander replacement belt. Purchase the belt from a hardware store or fine woodworking store, and look for a high quality and presumably long lasting belt. The better the belt, the longer the sticks will last, and the better they will work.

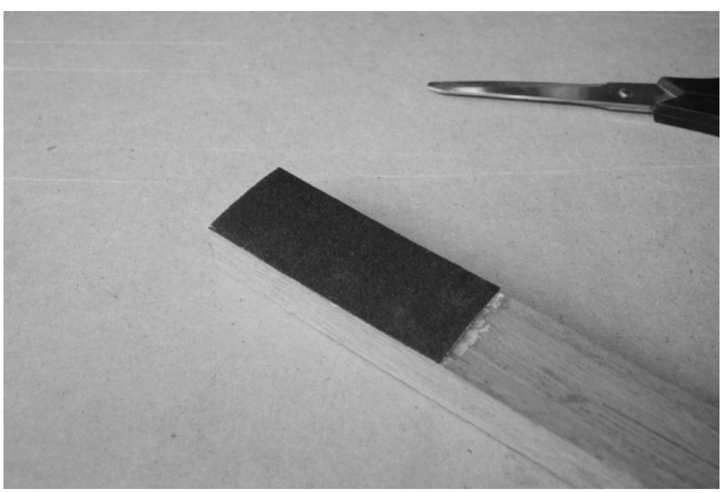


Cut the belt in half using a sharp scissors, and lay one end over a small piece of scrap wood. This stick happens to be 1-1/2" wide and 12" long, but it will be cut down later. Lay the piece of sandpaper over the face of the stick to get an idea of the amount that will be needed. Then, cut the piece off using the scissors, being careful to make the cut as straight as possible.

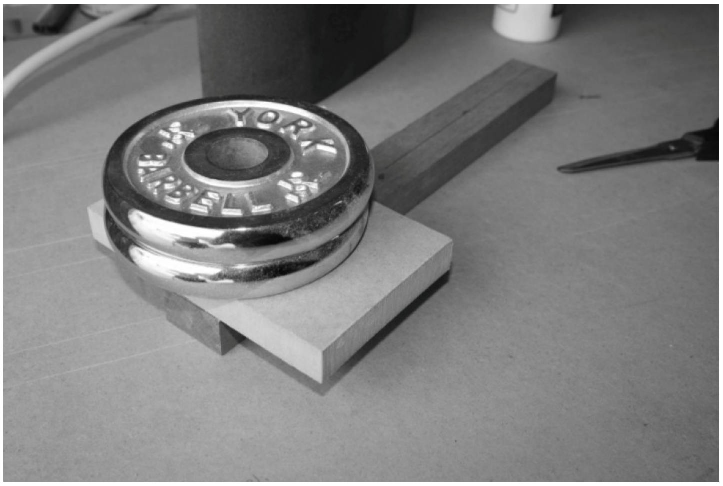


Apply a layer of glue to the face of the stick that is enough to cover the area that the sandpaper will be attached to. Press the piece down tightly with the fingers, making sure it is attached well. Franklin Titebond is perfectly fine for this application, though contact cement or contact adhesive can also be used with success.

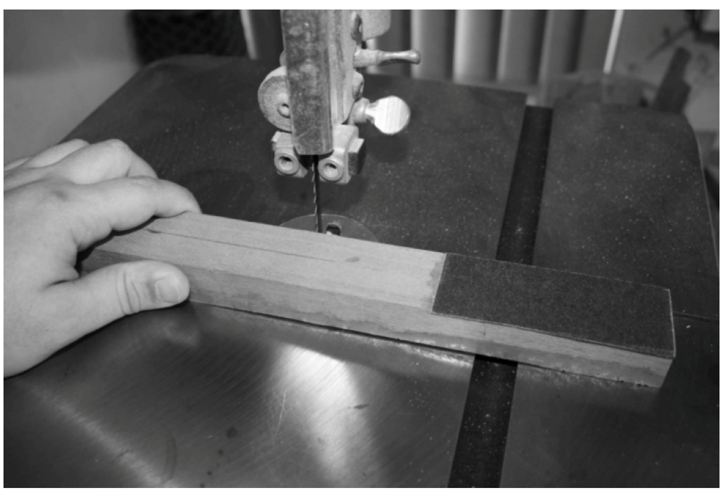
Lay the piece of sanding belt to be attached to the stick next to it, to ensure that the proper amount of glue is being applied. Once the glue has been spread around evenly, lay the piece of sanding belt on top of the stick and begin pressing it in place.



After a few minutes of finger pressure, the belt segment should stay in place by itself.



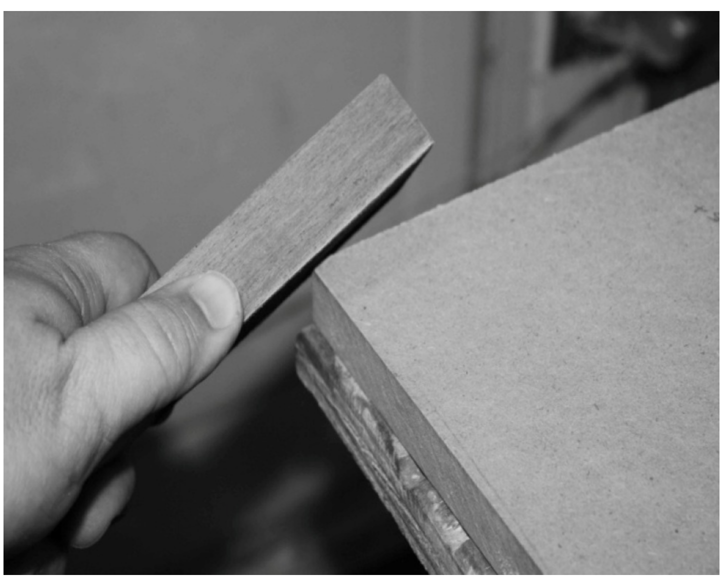
With the belt in place, lay a piece of wax paper over the top, followed by a flat wooden clamping caul and some gym weights to keep everything flat and even. The caul can be any flat piece of wood large enough to cover the sandpaper.



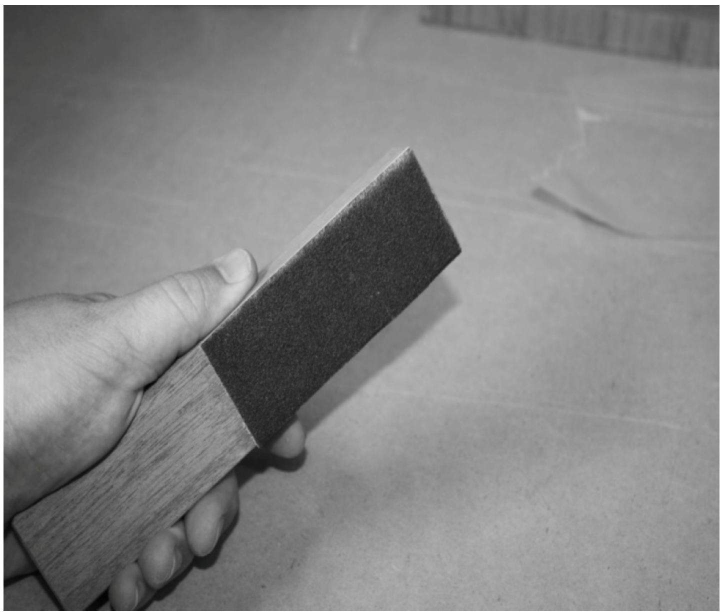
Allow the glue to dry for several hours before going back and removing the weights as well as the caul and the wax paper. Inspect the joint between the two pieces to ensure that it has adhered well, and that there are no bulges or bubbles under the belt. If there are, try and press them out using a clamp. If the glue is still wet, this will work. If not, peel the belt off the stick and try the gluing process again until the segment of belt ends up completely flat.

Cut off the long end of the stick until it has enough grip that it feels comfortable in the hand. A grip of 4" - 6" is best, and more can be left for those who like a larger grip.

Once the piece has been cut on the band saw, bring it over to the belt sander and refine the edges by rounding them. Knock down any sharp corners as the sanding is done, and try making the tool as comfortable to hold in the hand as possible.

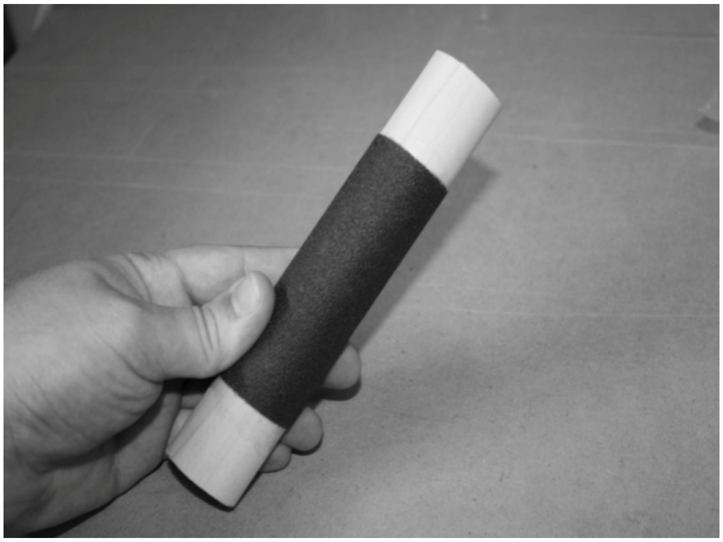


When the tool is complete, it can be held in the hand as seen in the picture above, and used to flatten an area of the guitar. The advantage to using a wood backed sanding stick over a piece of sandpaper in the hand, is that the wood backed stick will remove more material, and leave a flat surface behind.

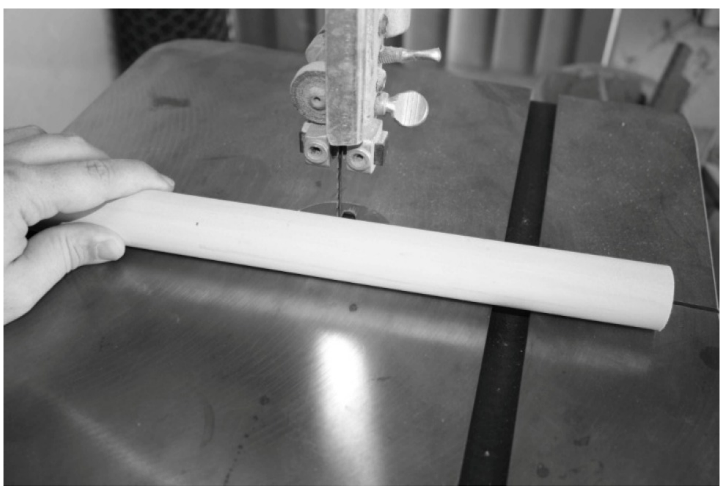


The completed sanding stick can be seen in the picture above, and is ready for use any time a strong sander is required. The piece fits in the hand well, will remove material quickly, and will easily find several uses in the busy guitar shop.

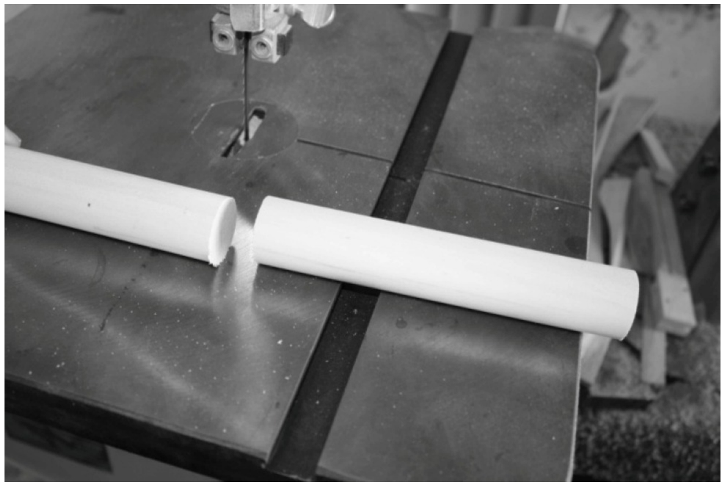
Making these with a rougher grit level will encourage them to be used when a rough sanding or large problem needs to be ground off. For delicate sanding, sandpaper backed by the hand and used lightly will leave fewer marks, and leave a finer guitar surface. These sanding sticks are designed for tough use, and to remove material rapidly.



Another sanding tool with many uses is a dowel wrapped in sandpaper. Many times, sandpaper is simply wrapped around a dowel and held in place with finger pressure. This will work fine, however much energy and effort are lost by having to hold it together the entire time. When the sandpaper itself is glued to the dowel, it becomes one tool that can be held by any hand without having to worry about whether or not the sandpaper will fall off.



Begin by cutting a dowel that is at least 1" in diameter to a length of 6" or more.

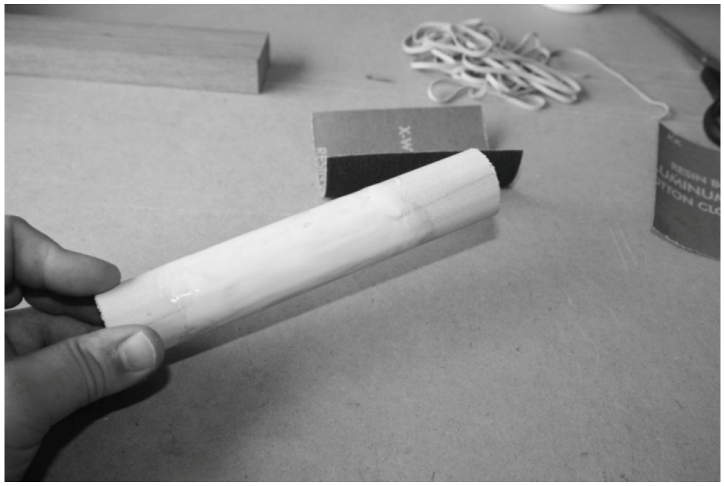


If a longer piece is desired for a better grip, cut the piece to 8" long instead of 6".

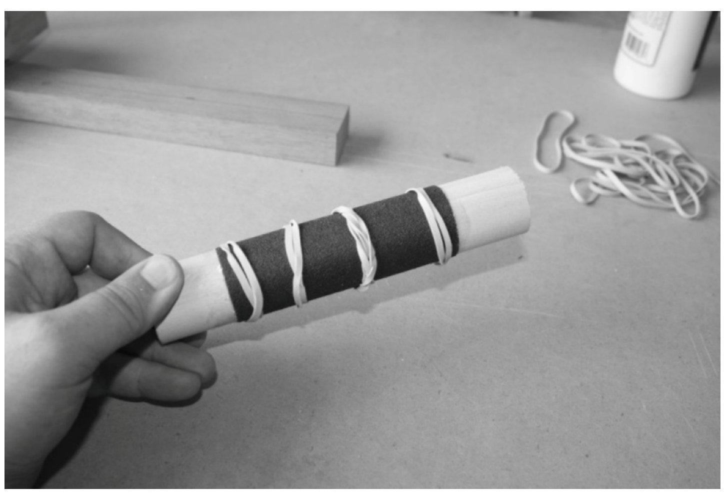
Wrap a piece of the sanding belt around the dowel rod in order to get an idea of where it will need to be cut. As long as the edges meet closely without overlapping, a small gap is fine between the edges. A pencil can be used to mark the rear side of the sandpaper where the cloth is, which can be used as a cutting guide.

It is much easier to have a small gap between the ends of the belt when wrapped around the dowel than it is to have them overlap. With a small gap, nothing needs to be done except not use the gap to sand a part of the guitar. With an overlap however, the area must be trimmed, otherwise a

bump will be sanded into the surface of whatever the sanding stick is used for.



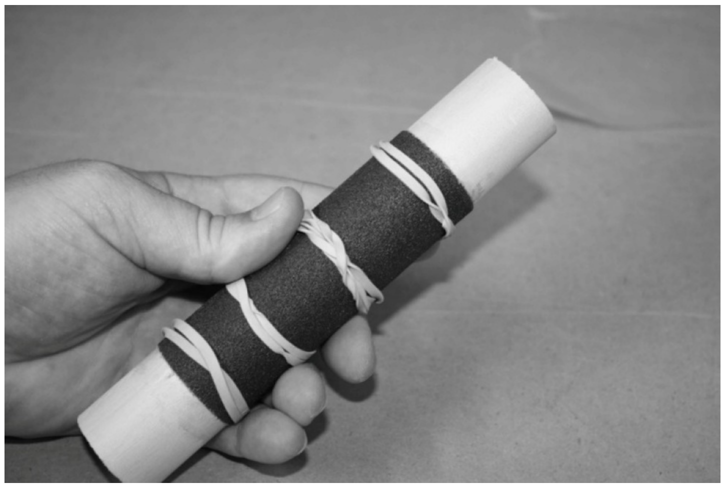
Dispense some wood glue onto the dowel, and rub it all around the area where the sandpaper will be secured. Use a finger or a glue brush to make sure it is a thorough coat. Every place where there will be belt to dowel contact there needs to be at least a thin layer of glue.



Wrap the sanding belt around the dowel by hand, pressing it against the surface all over with the fingers. Once the belt looks like it is holding well, start wrapping rubber bands all around the dowel that are evenly spaced. Put as many rubber bands as needed to keep the sanding belt

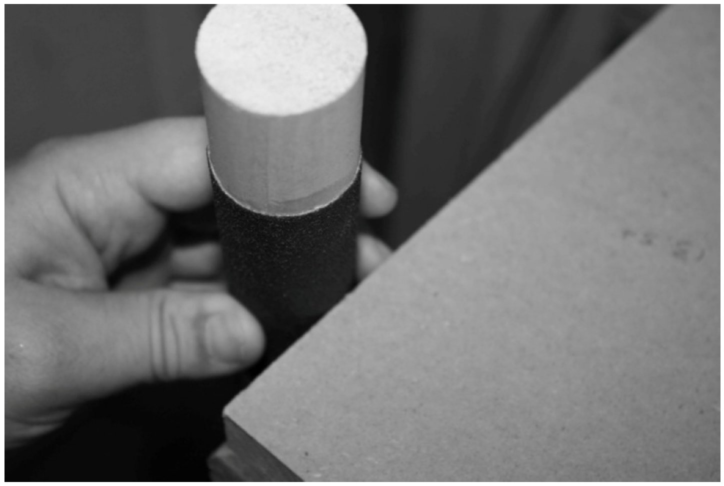
in place, which should not be too many since sanding belts are rather stiff anyway.

Once several rubber bands are in place, set the dowel aside to dry for several hours, securing the sanding belt to the dowel permanently.

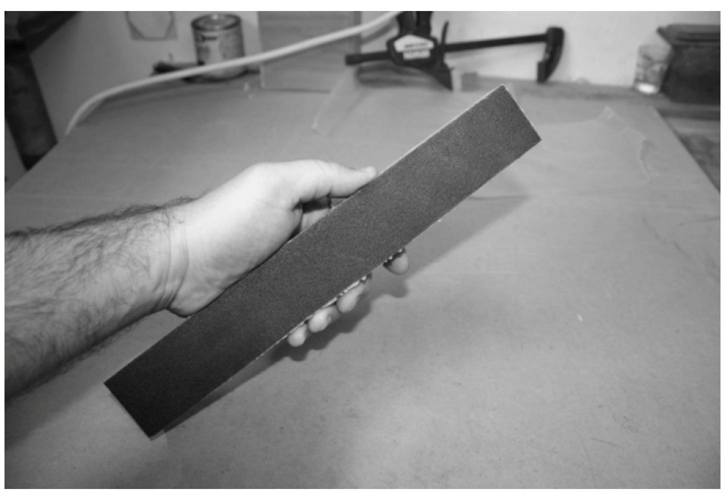


After several hours of drying, remove the rubber bands from the dowel.

Any time a curved surface needs to be sanded, or a hard to reach non-flat area, the sanding dowel will be the perfect fit.



The tool can be held in several ways, and each way will have its advantages. For evening out a soundhole, holding the dowel by the center to keep it straight will help smooth out a rough soundhole, and ensure the edges are not beveled too much. Holding it by the end while sanding the curves where the headstock blends into the neck will help to carve these areas perfectly, as well as help make it a quicker process. Rounded sanding blocks are great in the waist area of the guitar for reducing binding to be flush with the guitar, and also help when sanding the internal braces before joining the body pieces.



Finally, a large sanding stick such as the one seen in the picture above can be used for many tasks around the shop. A larger stick can be used to flatten and true a larger area like a fretboard or guitar back, while

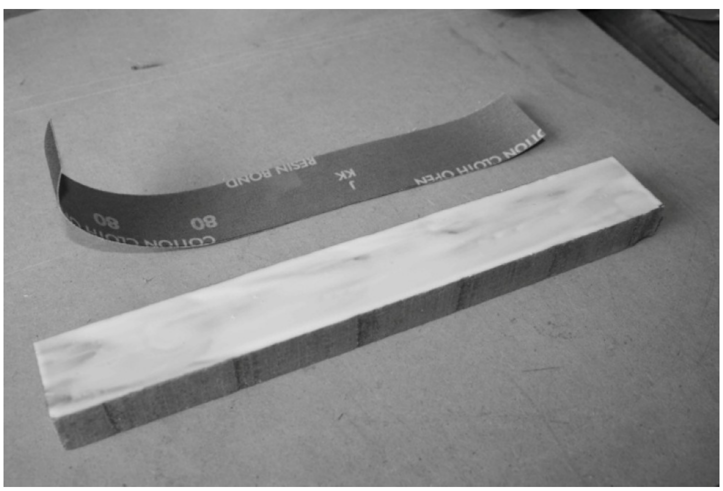
maintaining a flat surface beneath it. Bigger sanding sticks only require a lager section of belt to complete, and most of the time a sanding belt will contain enough material for several different shapes.

Begin with a piece of scrap that is 2" wide and around 12" long. The species should be something strong and durable like Oak, Maple, or in this case Spanish Cedar. The piece should be well seasoned so that it does not bend or crack over time, and should also be very flat.

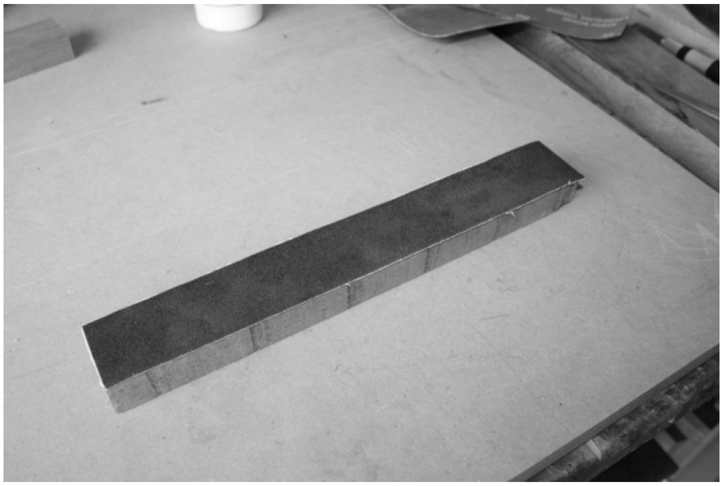
A piece can be flattened prior to use by rubbing it against a piece of sandpaper laid on a flat surface, until an even face is formed. It can also be ran through the planer, which will make a flat face very quickly.

Lay the board on the back side of the sanding belt, and line it up in a corner for marking.

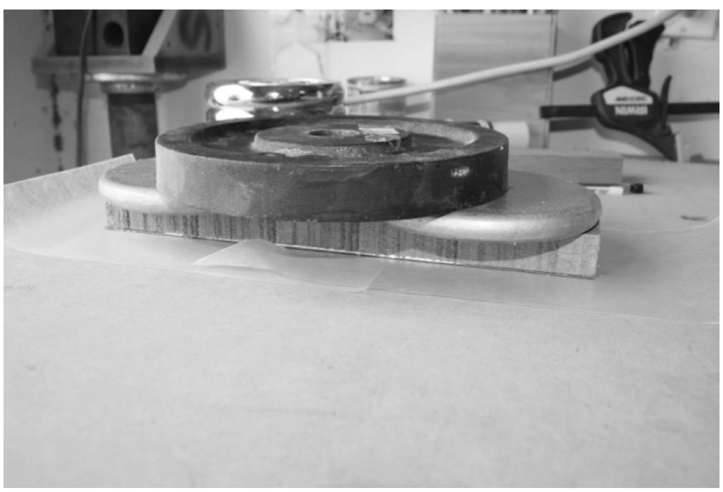
Mark directly onto the sanding belt with a pencil, which will show up far better than trying to mark on the rough area. Cut out the marked piece.



Test fit the piece on top of the sanding stick to make sure that the fit is correct, then spread some glue on the face of the stick. Make sure the entire face is covered with glue, using a glue brush if needed. As with the previous examples, Titebond wood glue is all that will be needed for a good bond.



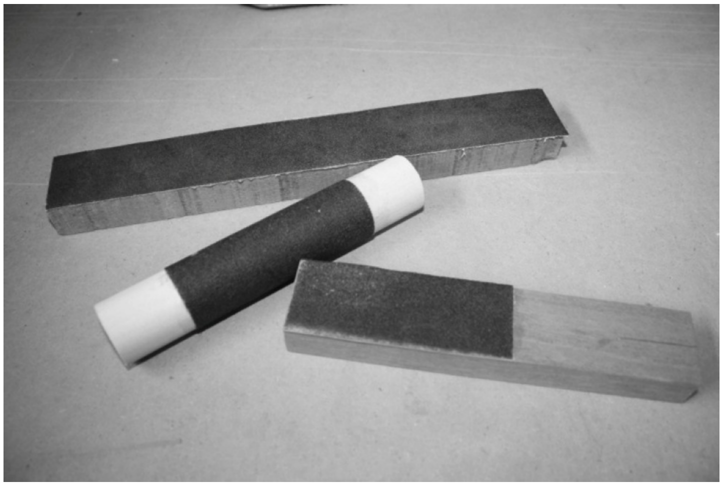
Place the cut section of belt on top of the glue, and press it in place as it is lined up evenly on all sides. Press hard by hand, ensuring good contact.



Lay a piece of wax paper down on the bench, followed by the sanding stick with the belt side against the wax paper. Lay a few gym weights over the back side to hold the belt in place while it dries.

When the stick has been allowed several hours to thoroughly dry, remove the weights and separate the wax paper. Bring the piece over to the belt sander to round the rough edges and break any sharp corners that are around the sides. A comfortable tool is used more often than an uncomfortable tool, so take the time to trim it out nicely.

Use this sanding stick any time that a larger area needs to be leveled, or any time a little more leverage is needed from the sanding stick. This kind of stick can really have some force applied behind it, allowing it to grind through thicker areas very quickly.



Make several of these sticks at one time if they seem like they will become a standard part of the guitar making system. A standard sanding belt is not very expensive, and will make several sticks that will last a very long time, even through heavy use.

The three shapes built in this section are only a very small segment of what can be built if needed, though they can be used for many things. Save a little of the sanding belt in a safe place just in case a need arises and a quick sanding stick has to be made. A custom shape can be created very quickly, covered with sandpaper, and used to make the tough job of sanding and shaping much easier.

Sanding sticks are very useful around the shop, and there are several instances where they will come in handy just having them around. New uses are always found for new tools in the shop.

EASY SANDING BLOCK

When sanding the guitar, having a solid sanding block behind the paper helps the process in several ways. First of all, the sanding block is flat, which encourages even leveling of the surface while working. Second, the sanding block spreads out the amount of area being sanded at once, which means that more of the surface will be sanded for the same number of strokes. Finally, sanding blocks make the process in general go much faster, which is less frustrating, and leads to a more thorough sanding.

When working on flattening and evening out the instrument, the biggest contribution from the sanding block is the ability to make the process easier. The final sanding of the instrument is the most critical step to getting a good looking finish, and unfortunately it is the step that is the most often rushed through.

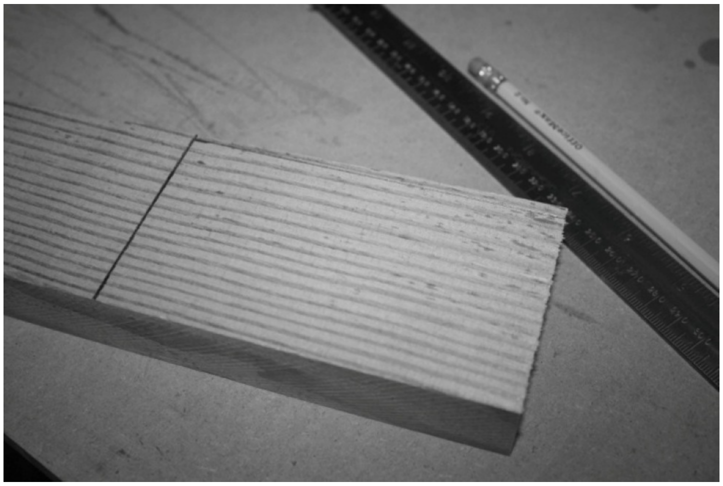
The final sanding should be given all the time it needs, because it will determine how well the finish looks. A few extra minutes here will mean much more than they seem, and can make the difference between a good looking and a great looking guitar.

The next time the final sanding is going to be done, try using a couple of these sanding blocks, and see how much faster and cleaner the process feels. A flat backing behind the sandpaper will spread out the area

that is being abraded, which means that more of the surface will be sanded each time the block passes by. This will make the process go faster, and with more even results.

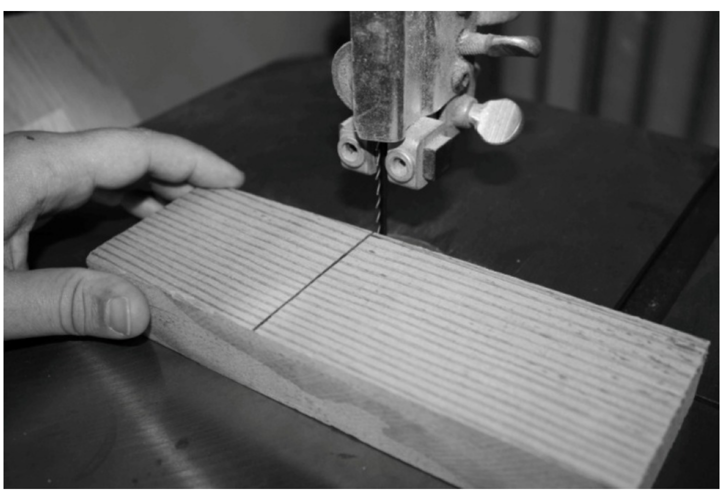
Making these sanding blocks is very easy, and they can be constructed entirely out of scraps if desired. The only thing that may be needed is a thin layer of cork, but this should really be in the shop anyway because it can be used for so many things. If making several different sizes, make one at first, and see how well it works. Then, look into making some that are larger or smaller depending on how well the first one worked. A good rule to follow is to make sure the blocks fit standard sizes of sandpaper, as well as custom sizes cut from larger sheets.

First, find a scrap piece of wood that is around 3" x 4", or something that can be cut down to that size. It should be 4/4 thick, and a non-splintery wood, because it will be held in the hands while being used. The cork will come from an office supply shop, and should be about 1/8" thick and is sold in a roll. A little bit of wax paper is also required to keep the wood glue from sticking to the bench while it is being glued.



Measure and mark out the width and the length for the sanding block, which can really be anything that feels good in the hand. This piece is 5" long, and 2-3/4" wide, which is very close to the original size of the block.

When selecting the size for the block, the only important thing is that it fits in the hand well, and is a nice and flat piece of wood. If the block were too large it would be hard to hold, and if it were too small it would not sand a larger area very well. Usually a 3" square or 4" square block will be fine for most people, though in this example the block used is a rectangle, which is fine too. If making a rectangular block, simply make it a little longer with the grain, but not so long that it cannot be held down easily.

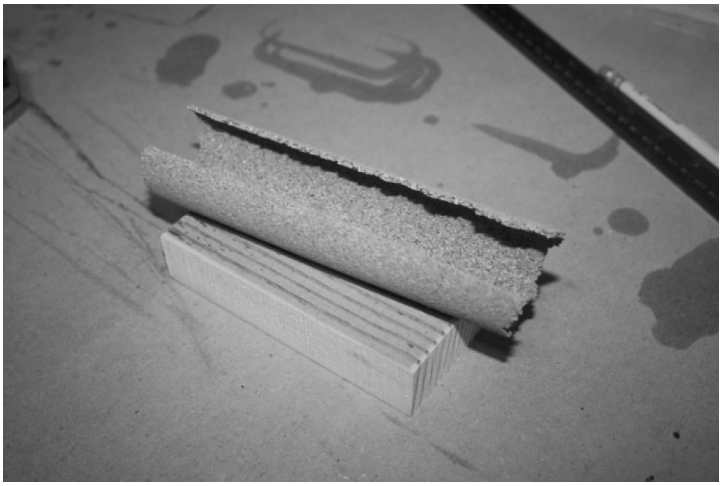


Cut out the block following the lines, using the band saw or a table saw. Be sure to make the cuts as square as possible, using a miter gauge if needed. A well made tool is a well cared for and well used tool, so perform every step carefully.

The edges and the freshly cut areas of the sanding block will need a thorough sanding on the belt sander to remove any tool marks. The faces should be fine since this was already a flat piece of scrap, however the edges and the end grain will need to be flattened.

Also, the top of the block where the hands will hold it can have the edges beveled significantly in order to make holding the block as comfortable as possible. Bevel the bottom edges that will receive the cork backing a little as well, but not as much as the top.

Allow the sander to hit all the faces of the block, with the exception of the face that will have the cork backing glued to it. This face should already be flat, and any further sanding may make it uneven. If the surface does need some work, due to the chosen board not being completely flat on the faces, feel free to flatten those areas as well. When choosing a piece to use as the block, it is easier to choose a board that already has flat faces than to choose one that does not.

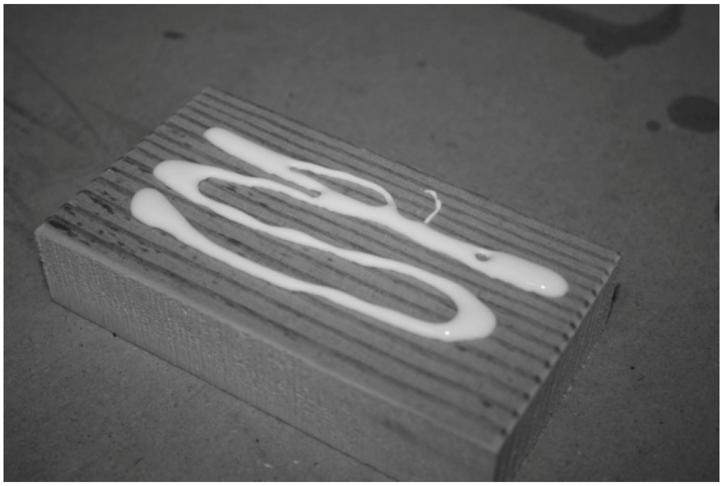


Once the edges have been sanded, and the block looks uniform and even, the cork backing will need to be measured and cut. Lay out a small piece of cork over the block, and carefully cut a piece that is a little larger than the face of the block. This will give a little extra allowance around the edges to make sure the gluing process goes well.

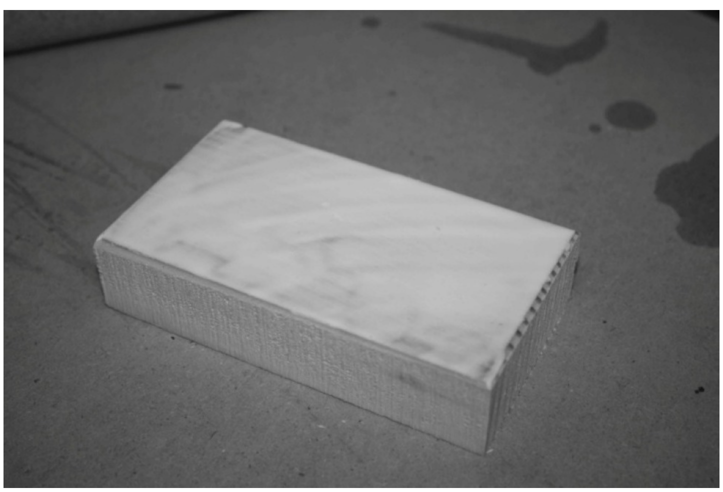
Test fit the piece of cork over the face of the block without any glue between them. The cork should be a little larger on all sides, and should have plenty of room to cover the entire face.

The gluing process will begin in the next couple steps, and to get ready for it, a few supplies will be needed. Several gym weights or a large heavy object can be used to weigh down the piece, ensuring the cork makes contact with the block the entire time it is gluing. A little bit of wax

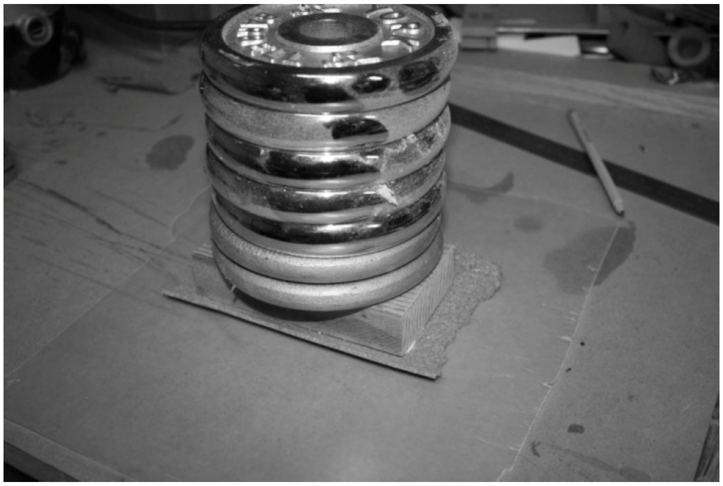
paper to keep the piece from sticking to the work bench is also needed, and some Titebond wood glue. Having all of these ready at this point will make the gluing process go much more smoothly.



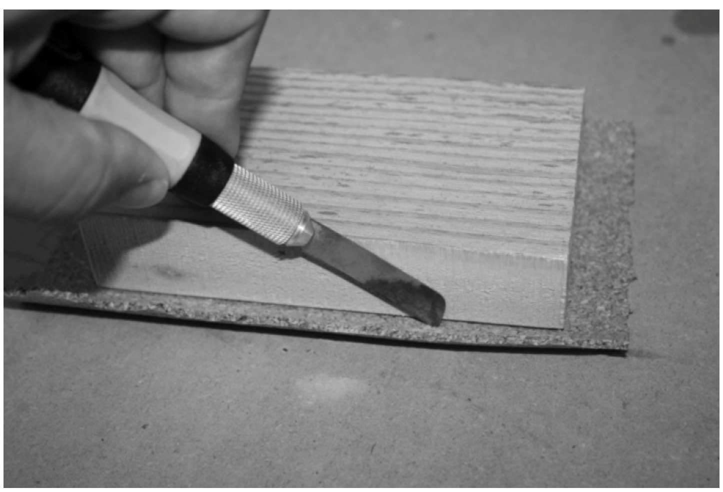
Apply glue directly to the face of the block that will receive the cork backing.



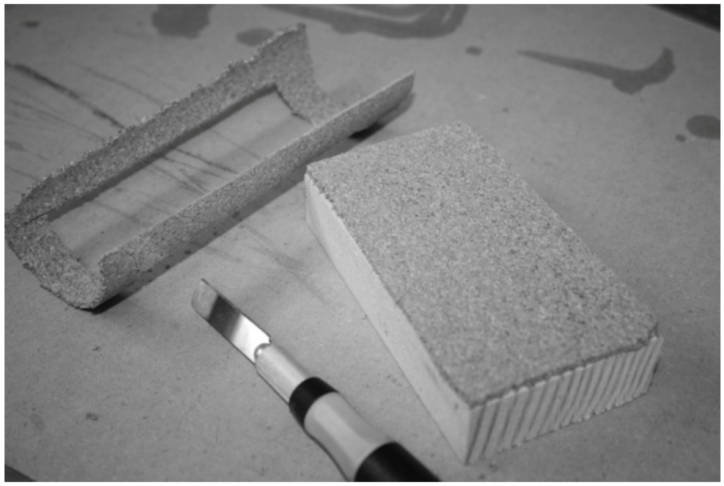
Spread the glue evenly with the fingers or a glue roller, making sure the entire face is covered all the way to the edges in a light layer.



Place a small piece of wax paper on the workbench, and then place the block with the cork side down on top of the wax paper. A few gym weights can go on top of the wood, which will spread out the pressure and ensure that the cork stays in place the entire time it is being glued. This can be left just like it is for several hours or better overnight. Once it has had time to dry, the weights can be removed, the wax paper carefully peeled away from the cork, and the glue up inspected.



Using a razor knife or hobby knife, carefully trim around the edges of the piece, removing any excess cork. This should be a fairly easy set of cuts, since cork is a very soft wood. Trim as close as possible without tearing off any of the cork from the face of the block.



With the excess trimmed away, the block should look something like the picture above, a solid piece of wood with a thin layer of cork glued to one face. The joint can now be inspected a little better, since the excess cork is no longer in the way.

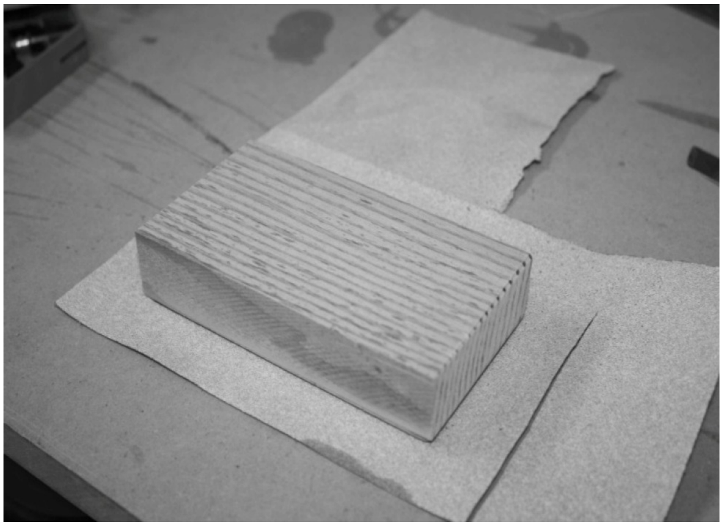
Since the cork is the face of the sanding block, and will transfer any anomalies to the surface of the wood being sanded, carefully check the face at this point to make sure there are no bubbles or valleys in the cork. Sadly, if there are, there is not much more that can be done except to start over and make sure the joint is clamped down better next time. It is far too much trouble to remove the cork, and glue on a second layer. Simply discard the block and start fresh with a new one if this happens.

Presuming that the gluing process was done well, and the face is completely flat, the edges of the cork will now need a little attention in order for them to be more functional. Since the edges were only roughly cut with a razor blade knife, they are really ragged, and can catch and tear off while sanding with the block. This will ruin the block, which means the edges must be beveled.

The picture above shows the edges of the cork after all of them have been beveled evenly on the belt sander. The bevel is not very large, but it is large enough to make the cork meet the edges of the block evenly. The point is to eliminate any rough areas that can catch while working with the sanding block, as well as make a better looking tool.

Sand these edges and bevel them carefully when using a powered sander, because the cork is a very delicate material. A couple seconds on the belt sander can go completely through the cork, and take off far more than desired. Touch the edges softly and touch them briefly to the belt sander, and check the piece often as it is shaped.

A small piece of sandpaper temporarily wrapped around a piece of wood can serve as an impromptu sanding block which can also do this job with a little less stress for those that are not used to using their belt sander. The process is the same, simply bevel the edges of the cork all the way until they are flush with the edges of the sanding block.



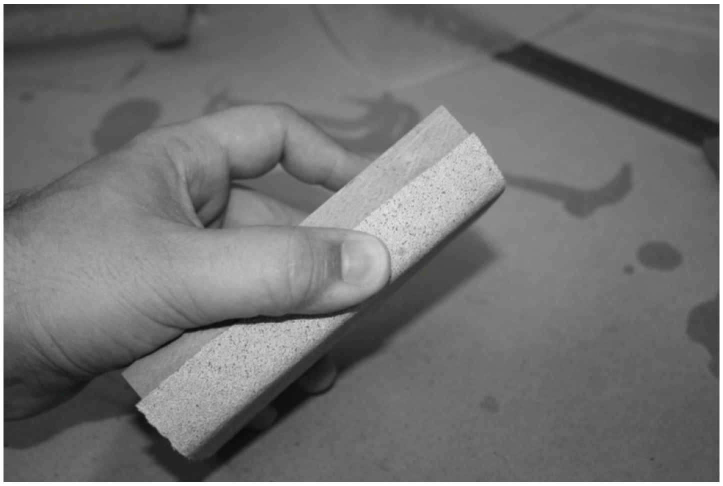
Place the block onto a piece of sandpaper to get a feeling for how much will be needed to cover the face. The sides of the sander are going to need to have a little extra over them in order for the block to work well, and to give the thumb and fingers something to hold into.

Being a simple sanding block without any hold downs or fasteners for the edges of the sandpaper, the fingers actually hold the sandpaper in place while the tool is being used.

The piece that is cut should be the same length as the sanding block, and a little longer on each side than the width of the block. This will

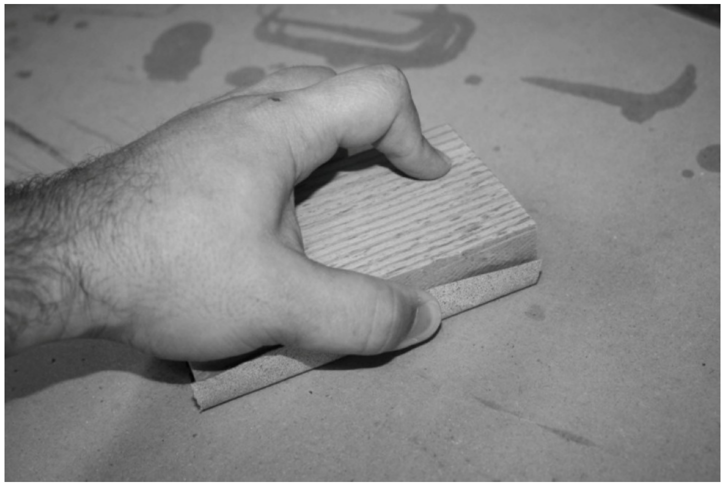
result in a piece that goes edge to edge one way, and wraps up the other two sides a little bit for the fingers to hold in place.

The pictures on the following page will show what this all looks like, as well as how to hold the sanding block when using it, and how to keep the sandpaper in place.



The picture above shows clearly that the sandpaper is only as long as the block from front to back, which is not an issue because it is moved from side to side while sanding.

The entire bottom of the block is covered with sandpaper, leaving none of the cork exposed to the surface of the project being sanded.



Hold the sanding block as seen in the pictures and press the thumb and fingers against the edges of the paper overlapping the sides. To use the sanding block, move it side to side rather than forward and backwards, which will ensure the edges of the sandpaper do not tear, and end up ripping off. If the sanding block was used in the other direction things could slip under the sandpaper, since it is not wrapped around those edges.

Using the block side to side presses the wrapped edges forward and backwards along the wood, and they will not rip or come loose as long as they are held tightly. Also, small pieces of sanding grit will not become trapped under the paper.

Two benefits of this style of block are the ease of making it, as well as the quickness in changing papers. All that has to be done to change grits is letting go of one piece of paper and placing another around the block. This makes it much easier to switch between grits and to change out papers that have been worn.

Project Notes:

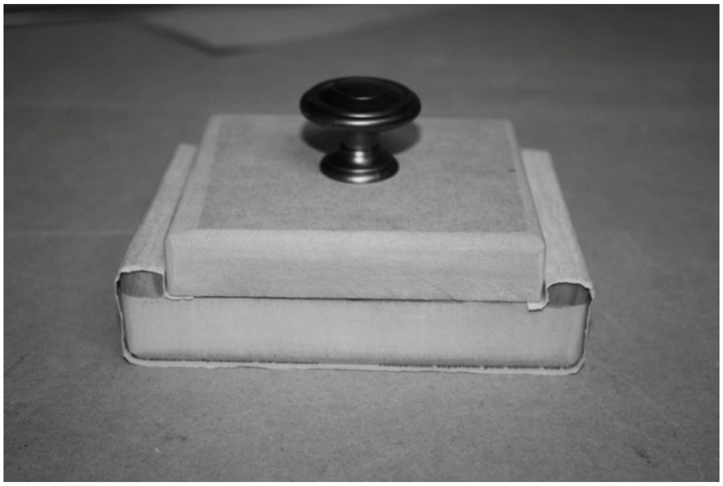
Several of these sanding blocks can be made very quickly and easily in a couple hours, and they will last a lifetime. When making a block, lay out and cut a few more in different sizes and shapes from the same piece of wood. Try out a few squares of different sizes, as well as rectangles. A certain size may become a favorite, and a few of these can be made later on.

Once they are made, cut a few pieces of sandpaper for each one, and have them ready in a certain place in the shop. This eliminates the hassle of trying to cut a piece of paper each time a different block is used, and makes the sanding process more enjoyable.

Finish the wooden areas with a light coating of boiled linseed oil or Tru-Oil to bring out the coloring of the wood as well as protect it from hand sweat, and the wear and tear it will endure in a woodworking shop. Let them dry several days before using them full time.

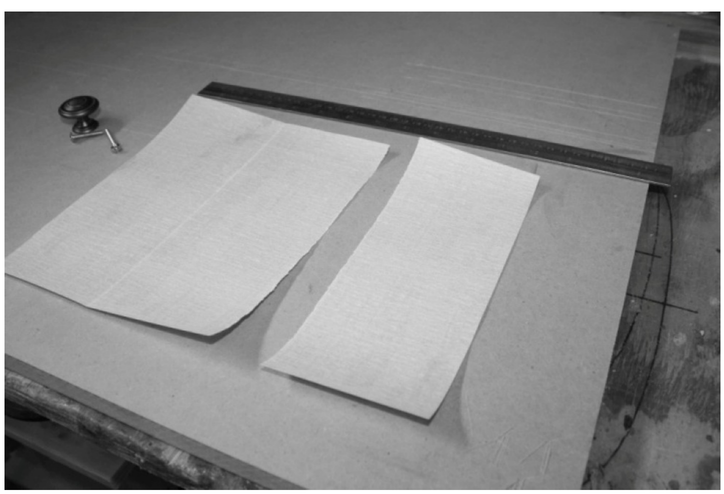
HEIRLOOM SANDING BLOCK

There are many ways to make a sanding block, including the method mentioned in the previous section. Though this makes an excellent sanding block, sometimes it is nice to have the sandpaper held in place by the block itself instead of the fingers. The heirloom sanding block is designed to be the kind of tool that is kept for a lifetime. It has a clamping system for the sandpaper, a nice looking pressure knob on the top, and can be made from higher end wood if desired. These are easy to make, so several can be made in different sizes to suit different needs.



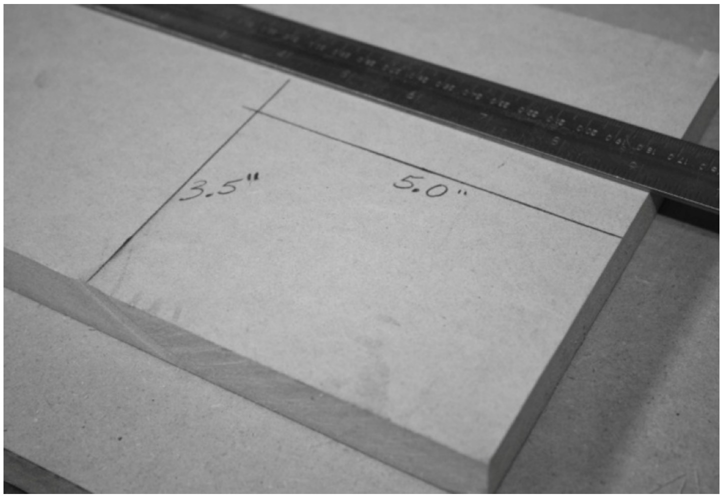
This sanding block can be made from scraps around the shop like in the pictures, or it can be made from nicer hardwoods and finished like a higher end piece. Either way it is made, the tool will function the same, and will be a good performing and comfortable sanding device.

To make the block, a few items will be needed, though most of these should already be in the shop. A nice looking metal knob can be found in the drawer and cabinet hardware section of a home improvement store, and needs to have a 1-1/2" long screw. If it does not, go to the machine screw section and purchase one that fits the knob. A full sheet of sandpaper will also be needed, as well as wood glue, scraps of wood for the tool itself, wax paper, and cork. The cork to be used is the same as in the other examples throughout the book, and it is 1/8" thick. Look in any office supply store to find this kind of cork, and again it is well worth buying a full roll because there will be many instances where it is used.



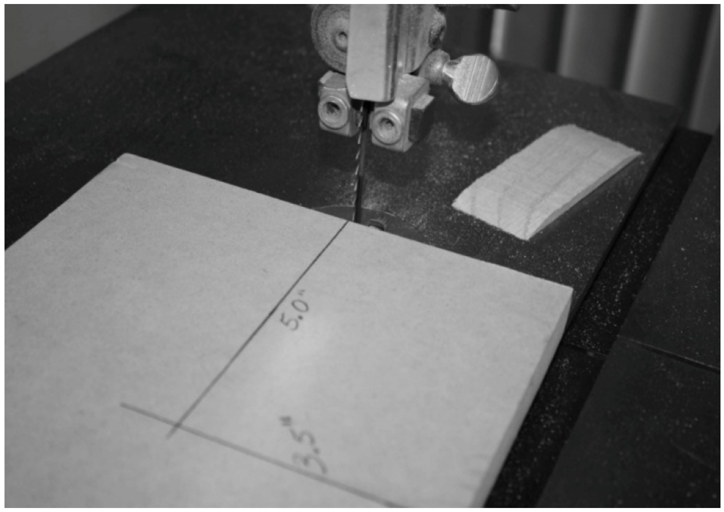
The sander in this example will be sized for a 1/3 sheet of sandpaper, so fold the sandpaper in thirds along the longer edge as shown in the picture above, and tear along the fold lines to separate the pieces. There

will be a little hang over on the sides of the sander when using a one third sheet, but this will help keep the sandpaper from tearing while the block is being used.

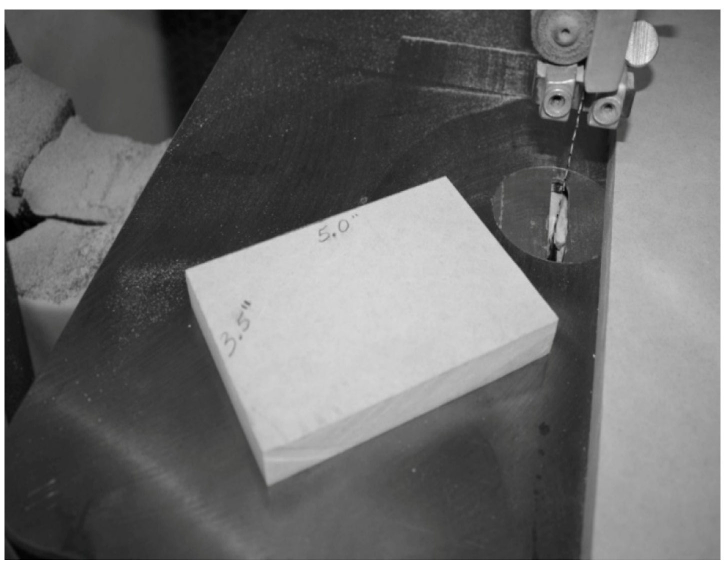


Measure and mark out a piece of flat wood that is 3/4" thick, marking one side at 5" and the other at 3-1/2". The width of the piece of sandpaper is slightly wider than 3-1/2", and the overall length of the sanding block will be 5". In order for there to be enough sandpaper to let the clamp work, this piece can be no larger than 3/4" thick, the reason for this will be very clear coming up. The ends of the paper need to wrap around the sander in order to be locked into place. If there is too much wood to wrap around, the paper will be too short, and the tool will not work as designed.

Unless making this from higher end woods, MDF is the best choice for the bottom piece because it is completely flat when it is manufactured, and stays that way over time.



Using a band saw, table saw, or hand saw, cut out the sanding block blank. Carefully follow the lines, cutting on the outside of them with the blade to preserve their dimensions.

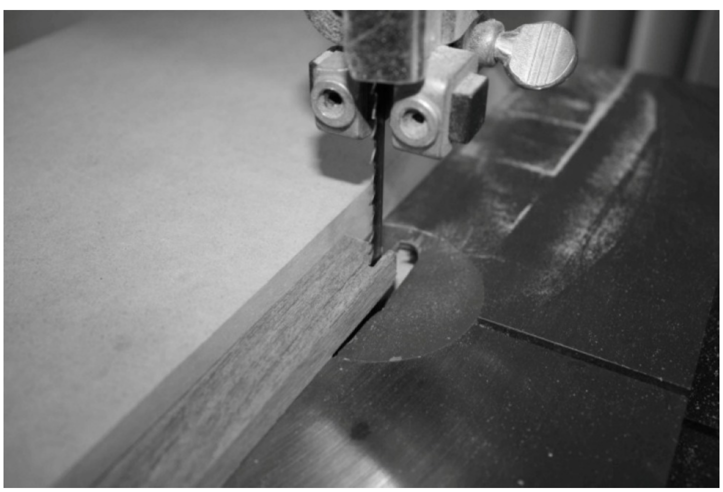


If several sanding blocks are being made at once, which would be useful instead of having to change papers when needing to change grits, cut all the blocks out at this time. It will be much easier to complete all of the steps on each piece while the tools are in place, rather than to have to go through the process from the beginning to the end each time.

A good number of blocks to have would be the same as the number of sandpaper grits used the most often in the shop. For most shops,

a block for 80, 100, 150, and 220 grit papers will be perfect, which would be four blocks.

Any edges of the block that were sawn will need a light sanding on the belt sander or by hand, and only to remove the marks left by the saw. Make sure not to go through the lines drawn on the surface, as this would alter the dimensions of the block. Do not round any edges at this point, which will be done later after a few more steps.

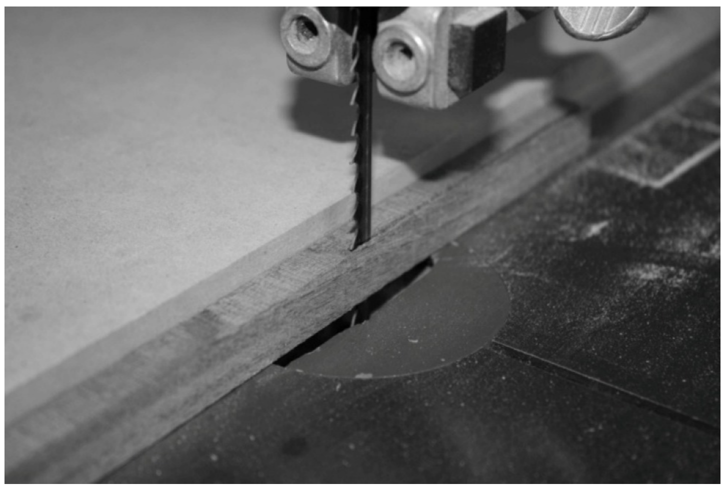


The small runners that go along each side of the sanding block and help to lock the paper in place will now be made. The dimensions for these pieces are 3-1/2" x 1/2" x 1/4", which will be just enough for the sandpaper to roll over and be held by the top block. The best way to

accomplish this is to make a long stick that measures 1/2" by 1/4" and then cut it down to length.

Place a stop on the band saw that is 1/2" from the blade. Lock it in place with a couple clamps on the table top, and give it one last check before turning on the saw. Keeping the piece of wood to be used for the runners against the newly made fence, run the piece through, ripping it to a 1/2" width over the entire length.

If this is being done on the table saw, use the fence and a zero clearance insert to make the cut, and use a push stick to keep the fingers out of the area of the blade.

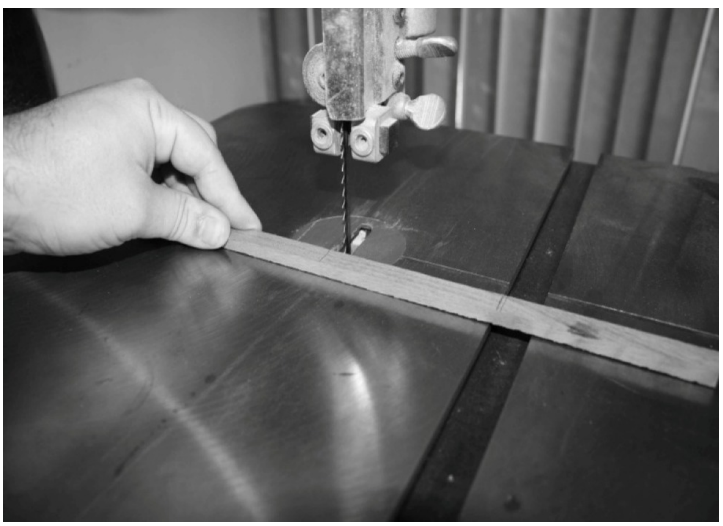


Re-set the fence on the bad saw to 1/4" from the blade, and check it before sawing. Run the piece through on the other face, which will result in a stick that measures 1/2" x 1/4".

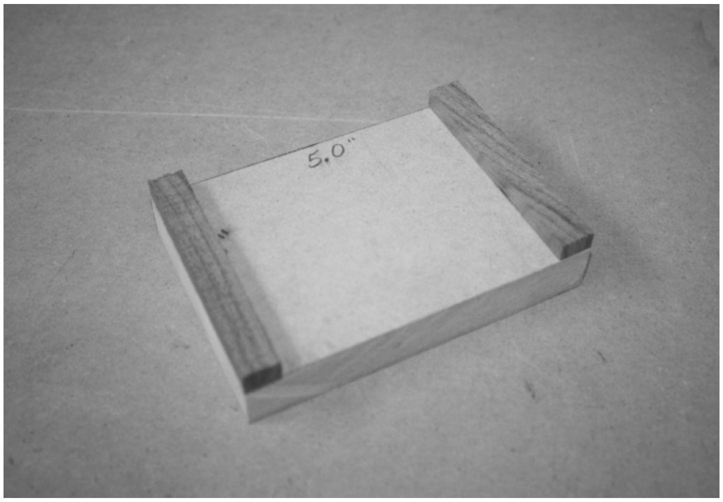
This is what the band saw fence looks like when zoomed out. The fence is really just a piece of wood that is clamped to the table top. Any time the band saw is needed for rip cutting, this method can be used.

The resulting stick should be long enough to do several clamps, and will be easy to cut to width in the steps coming up.

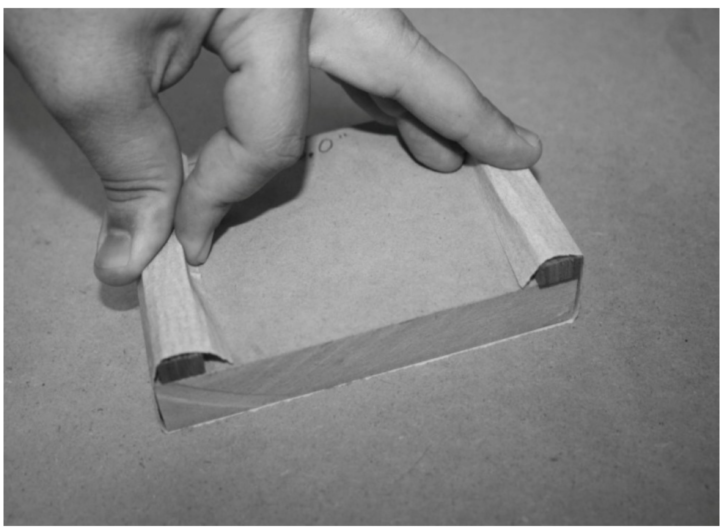
Use the sanding block as a guide for measuring, or simply measure the piece to be as long as the block is wide, which is 3-1/2" in this case.



Cut the piece to width on the band saw, making sure not to cut through the line but outside it.

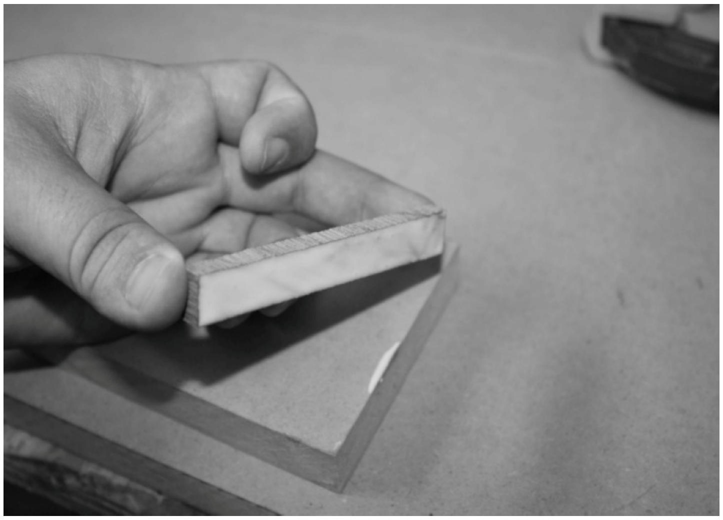


Test fit the pieces once they have been cut to see that they are large enough for the block, and go right to the ends. Again, if making several blocks, cut out all the runners that will be needed at this point while the setups are in place.



At this point it is worth testing out the fit to see if the sandpaper will make it around the block, especially if making a custom size. It is interesting how much sandpaper is used up when it is wrapped around both edges like the picture above. The cork is not in place at this point, but it will only remove 1/8" of length from each end of the paper, so it should not be too much of an issue unless the paper barely fits during this test.

If making a custom size and the paper does not fit, there are a few things that can be done. The easiest is to cut down the length of the sanding block to reduce the length of paper needed. Or another method would be to reduce the height of the main sanding block, or the widths of the runners. All these changes will be small however, when compared to reducing the length of the sanding block.



Apply glue to the bottoms of the runners once it is apparent that the sandpaper will fit around the block. Press them in place on the edges of the piece, making sure to get the glue distributed well inside the joint. Slide the piece from side to side along the length to ensure good glue contact, and then repeat this on the other side.

Clamp the runners to the main sanding block with four bar clamps or any other strong clamp that is available. Make sure that while the clamping is being done, that the pieces do not slide around and get out of alignment. The best way to do this is to get all the clamps into position with medium or light tension, then tighten them down after they are all in place.

Flip the piece over once the glue squeeze out has solidified a little bit so that the bottom can be drawn on. Find the center of the block using a ruler, and mark it clearly.

The way this sanding block works is through pressure between the upper and lower pieces, holding the sandpaper in place. In order to

create that pressure, a screw is inserted through both blocks, and the knob is used to apply the tension from the top. In order to make this work, the screw needs to be inserted through the bottom of the sanding block, as close to the center as possible.

Measure from corner to corner, or center to center depending on which way the clamps will allow, and mark the center point. Use an awl to make a small indent for the drill to follow in the center of the marks.

Select a Forstner bit that is slightly larger than the head of the screw that will be used with the drawer knob, and chuck it in the drill.

Line the drill up with the mark made by the awl, and drill down 1/4" into the piece before stopping.

The quarter inch counter bore to sink the head below the face serves a couple purposes. First, the head will obviously need to be beneath the surface otherwise it would not be a flat surface for sanding. Second, since the top and bottom pieces of this sanding block are both 3/4" thick, a 1/1-2" bolt will not go through far enough to come out the other side. Sinking the bolt leaves about 1/4" exposed on the top of the sanding block, which is enough for the knob to grab on and apply tension.

Measure the screw being used for the drawer knob, and select a drill that is just wide enough that the screw can pass through without needing to be turned with a screwdriver. It should be snug enough however that it does require a little pressing to get it through. Test this out on a scrap

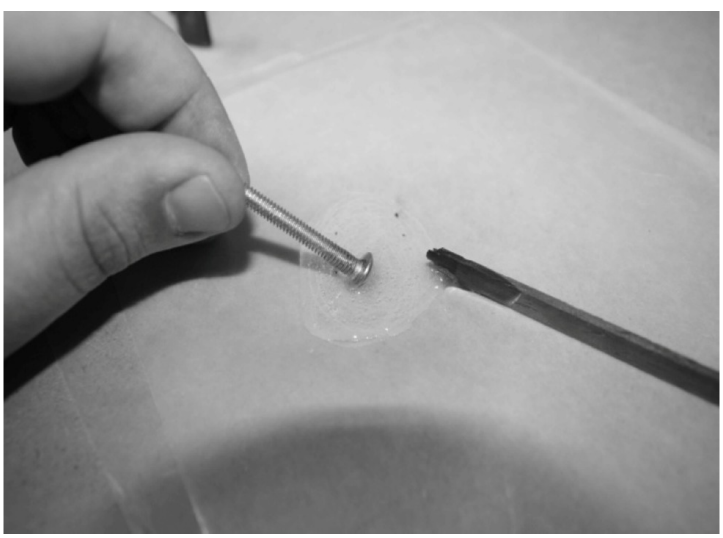
piece of the same wood being used for the bottom of the sanding block, until a suitable size is found.

The reason for this tension is to create a dam against the epoxy that will be poured into the hole coming up. The epoxy will need to be confined to the Forstner hole, and not allowed to drip through the shaft hole as it cures.

Insert the screw through the hole to check the alignment as well as the fit. Again, the screw should not simply fall through the hole, but should require a little push to get there. The head should clear the sides of the hole, and should stand up straight when flush against the bottom of the counter bore. If the holes are done well and the screw is straight, the hole can now be filled with epoxy which will keep the screw in place as well as fill in the hole on the bottom of the sanding block.

The next step in the process is to use some two part epoxy to fill the hole in the center of the lower block. It is important to have a flat gluing surface for the cork to be laid over, and this hole will leave a depression which will not sand well.

The best epoxy to use is the five minute type, which will set in five minutes, be hard in 20, and be workable in several hours. This will also ensure that the resin hardens rapidly enough to keep from dripping through the screw hole.



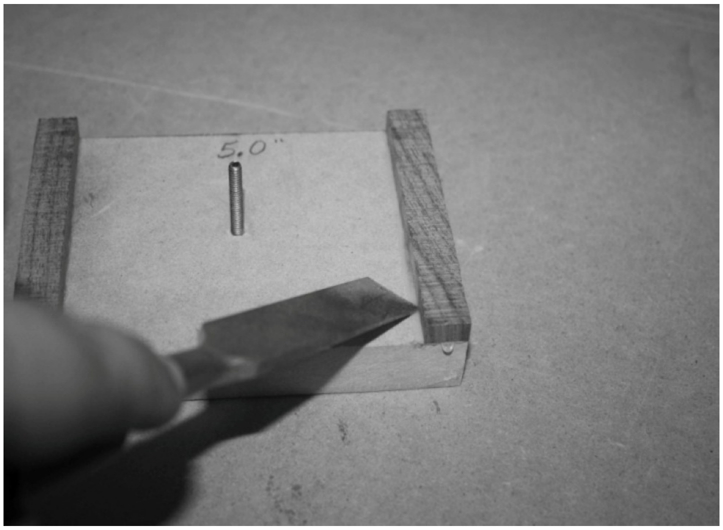
Mix the epoxy and hardener as described on the container, using a piece of folded wax paper as a disposable mixing dish. Mix it for several

seconds, using a piece of thin scrap wood as a stirring stick.

Dip the screw head into the mixture, making sure to get some epoxy on the uppermost half inch of threads. This will ensure that some epoxy gets into the hole itself, locking the shaft in place. When the top is coated well, drop the screw in the hole, and use the stirring stick to press it through tightly.

Scoop up little blobs of epoxy with the stirring stick, and deposit them inside the hole, completely covering the screw head. Fill the hole a little higher than level, which will be sanded back when the epoxy dries.

Leave the unit to dry for several hours, which will give the runners enough time to dry as well. Monitor the epoxy for a few minutes until the excess on the wax paper starts to become like the consistency of thick jelly. At this point the epoxy in the hole is also this thick, meaning it will definitely not drip through the hole, and can be left alone.



After several hours drying, remove the clamps and check on the center screw. The epoxy should be mounded up a little taller than the rest of the wood, and be hard as a rock. On the other side, any excess glue squeeze out will need to be removed with a chisel before fitting the top block.

It is very important to remove any excess squeeze out that has dried on the surface, because the fit between the top block and the rest of the piece must be tight. If there are bulges of glue stuck in the corners, the sandpaper will not lay correctly and the top block will not be able to clamp well. Use a chisel to remove all of this excess glue, or a file with a square corner. Be sure to remove glue only, and not any wood.

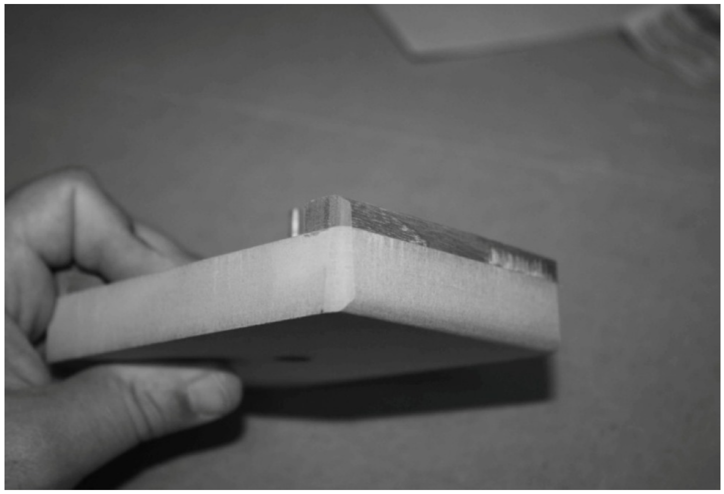
On the other side, the excess epoxy will also need to be removed, and this can be done in a couple ways. A chisel will take it off if done carefully, or a belt sander will also work. Sanding by hand is possible, but make sure to use a flat block behind the paper to ensure a flat surface when completed.

If a belt sander is available, this is definitely the best way to get a completely flat bottom surface, especially if it is wide enough to place the entire block on the belt. Getting the bottom smooth is the key to getting smooth results from the sanding block, so a little extra time here really pays off.

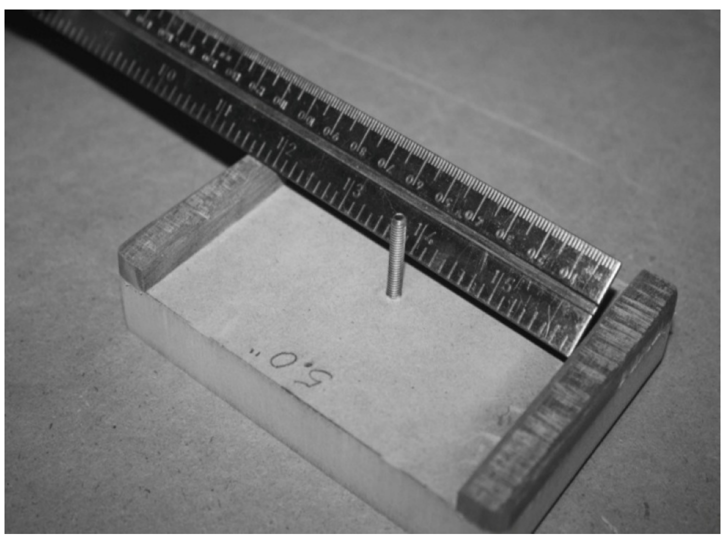
Once the bottom is level, a finger ran over the epoxy area with the eyes closed should be very hard to tell where the epoxy and wood meet. Also, if there are any dings or scratches on the bottom, take the time to remove them at this point before moving on to the next stages of building.

Sand the block on the belt sander, removing any sharp corners on the bottom and sides of the unit.

The outside faces where the sandpaper will wrap around need to be especially smooth, so they do not tear the paper when in use.

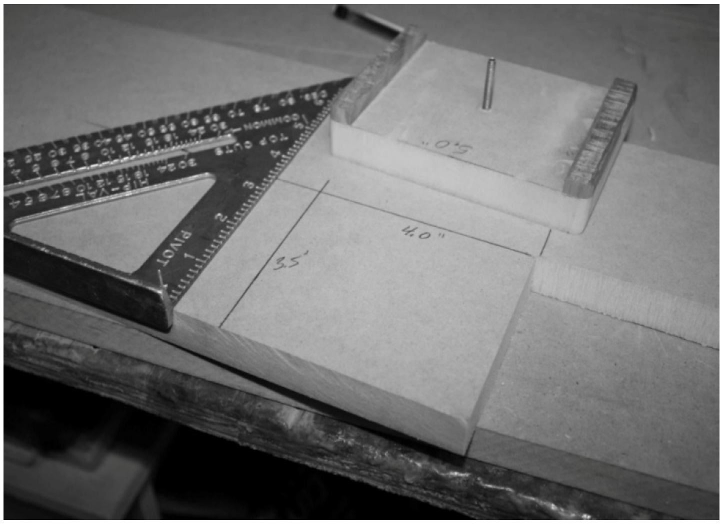


Round the bottom edges as well, but not too much because the cork will need to be glued in place later, and too much rounding can cause problems with the gluing caul. Knock down any rough edges around the piece using 220 papers, and the block will be ready to have the top piece made for it.



Depending on how well the runners were made, and how well the gluing went, some small changes may need to be worked into the design when it comes to cutting the top block. Do not simply subtract 1" from 5" and cut the block like this. It may end up being too short, which is not fixable other than by cutting another one. Instead, measure from edge to

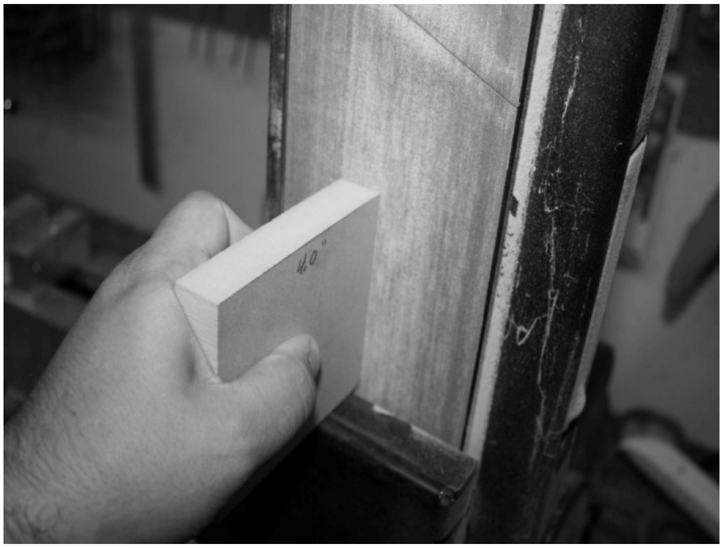
edge inside the runners, and mark the length a little too long by 1/16" to be on the safe side.



As luck would have it, in this case the piece was exactly 4", but it will still need to be laid out and cut to 4-1/16" and sanded back later. This will also factor in some possible twist in the runners, which may end up with one edge being wider or narrower than another.

Lay out the piece, marking the length and the width of the top block, which in this case is MDF again. The width will not change, and should be 3-1/2" which is the same as the lower block. Make the marks well, and cut the piece out using the band saw or table saw. Do not sand the edges at this point, because the top block will still need to be fitted to the lower block, which will require sanding anyway.

Test fit the top block on the lower block, and it should be a little too big, or a perfect fit depending on where the lines were cut on the saw. Mark areas that are too long and sand them on the belt sander carefully. It is far better to remove a little wood at a time and check the piece often than to cut too much off and have to make the whole top block again.

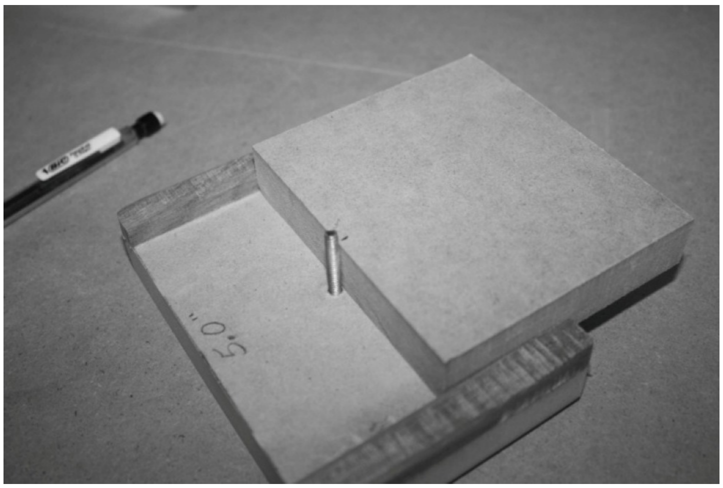


Only sand a little at a time before measuring again, otherwise too much may be removed.

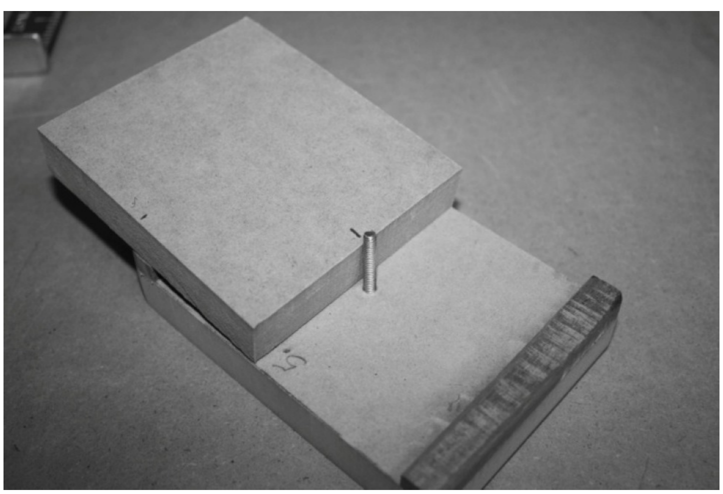
Once the top block fits easily into the lower block without having to be forced, the fitting process is complete. Once the sandpaper is in place, the fit will tighten, so make sure that it is not a tight fit at this

point. If the sandpaper is added later and the fit is too snug, a little removal of wood on the belt sander can be done again, making the fit better.

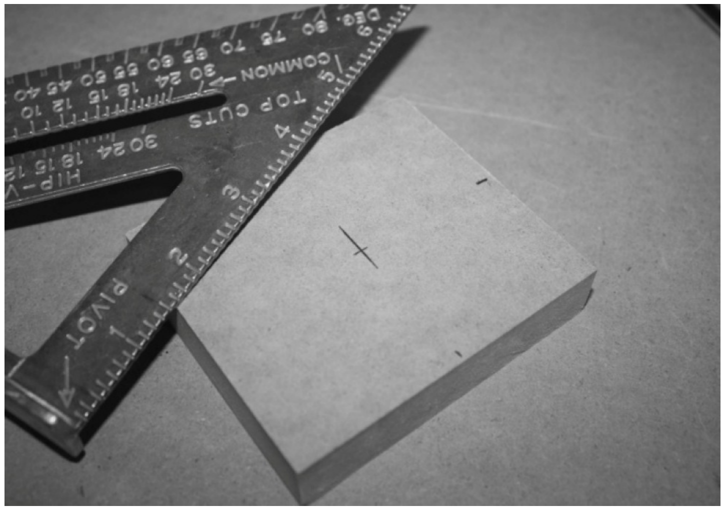
The fit can be best described as an easy drop in that does not move around in the slot very much at all, and does not require any extra pressure to be moved into place. If one edge of the lower block is narrower than another, concentrate the sanding in this area of the top block alone, so that the other end does not become too short.



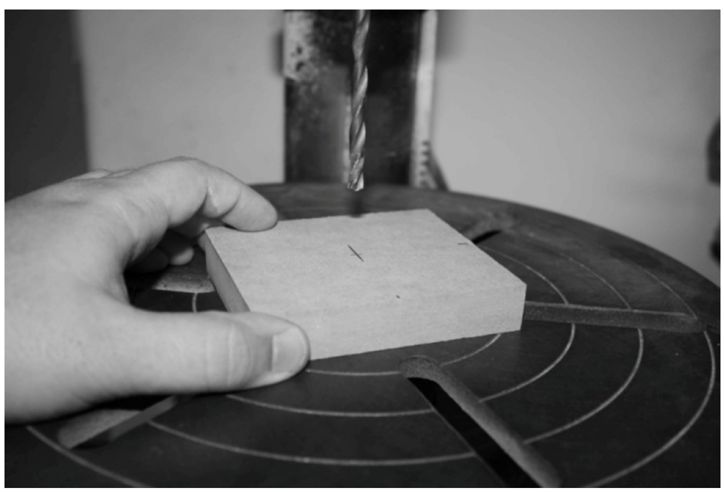
Measure and mark for the center hole to be drilled by lining the block up on one side and making a mark where the screw is.



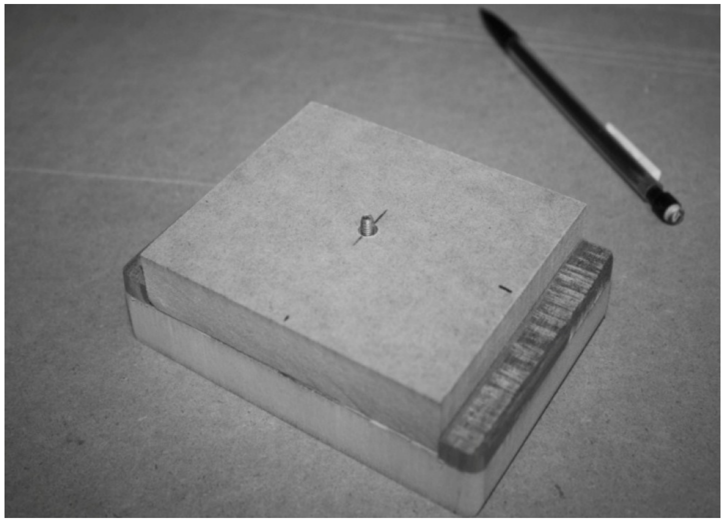
Then, lay the block like the picture above and make a second mark where the screw is.



Finally, connect those lines using a square, and where they intersect will be the place to drill the clearance hole. The screw that is fixed to the bottom block will need to pass through the top block without getting stuck, which means this hole will need to be drilled accurately.



Use a drill that is a few sizes larger than the screw which will need to pass through it, to ensure there is plenty of room. Make a mark with an awl at the intersection of the marks in the center to give the bit something to follow, and make the hole using a drill press if possible.



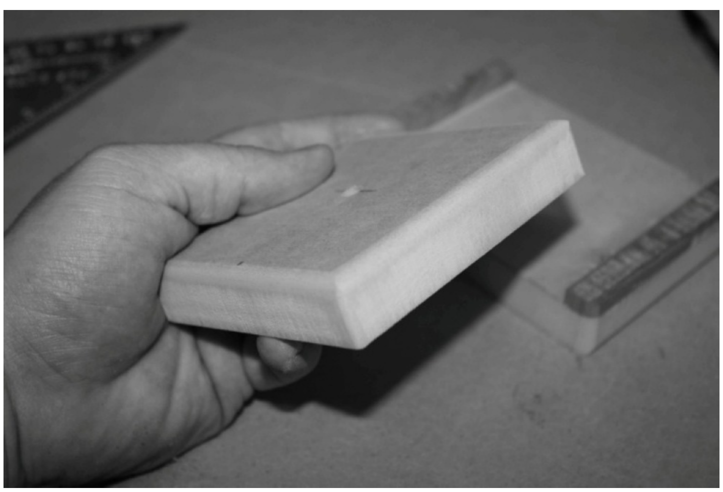
Test fit the top block on the bottom block by placing it over the screw and all the way down on the lower block. There should still be almost zero wiggle room, and the screw should pass through the hole easily.

If the hole was missed, it can be drilled larger to accommodate the error in measurement. The only real limiting factor on how big this hole can be is the base of the drawer knob, which will need to make contract with the top block in order to tighten the two blocks together.

Try the block a couple of different ways, including upside down, until one way that fits the best is found. Sometimes what looks like an error in hole placement is really an error in how the block is laid over the top. If no better way is found, simply drill the hole out a little larger until the screw passes through nicely, and the two block come together evenly on the edges.

Remove the top block and round over the edges that will make contact with the hands while sanding. Do not round the bottom edges at all, since they will need to remain sharp in order to grip and hold down the sandpaper. This can be done on a belt sander if done carefully, or on a router. If a router is used, a number of decorative bits are available, though a simple round over will do the job as well.

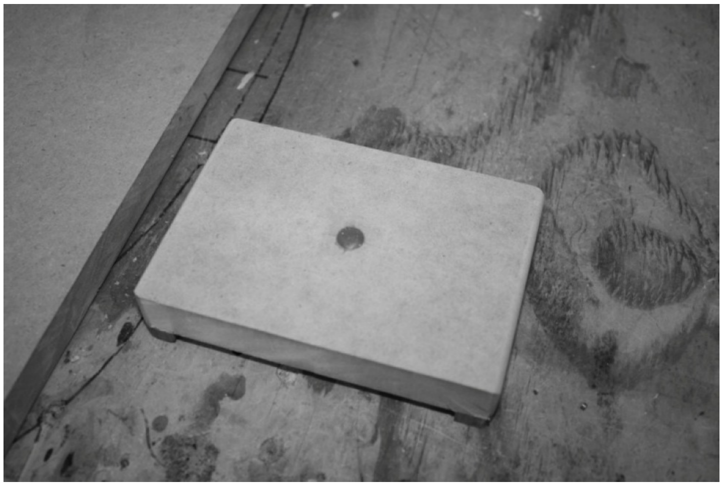
Next, sand the corners of the block, and round them over slightly, though not as much as the top edges were rounded. The corners will be easier on the hands this way, and the tool will be more comfortable to use.



Here is a close up of the piece after the shaping has been done on the belt sander. Again, a more complex shaping and decorating can take

place on the router table, however this is not necessary to the function of the sanding block. The edges along the top are well rounded, making a comfortable grip, and the corners have been knocked down as well.

The next phase will be to glue a layer of cork to the bottom of the sanding block, making the surface a little more flexible, and giving the sandpaper a nice backing. Place the top block aside for the next several steps, which will be performed exclusively on the bottom block.



Find a hole in the workbench and place the lower block upside down with the screw going through the hole. This way it lays flat on the bench.

Apply a layer of wood glue to the bottom surface of the sanding block.

Cover the entire surface with a piece of thin cork, pressing it in place to ensure that there is glue contact throughout the entire surface. The cork should be cut slightly larger than the block before being pressed down. Holding it in place for a few seconds will also help to stop the cork from curling up when let go.

Cover the layer of cork with a layer of wax paper, which will prevent any glue squeeze out from sticking to things it should not.

Place a flat wooden caul over the wax paper, which is just a piece of scrap measuring a little bigger on all sides than the sanding block.

Finally, place a couple gym weights on top of the wood piece, which will provide the clamping pressure needed, and hold everything in place while the glue dries. The cork will be held flat by the weights, and when the glue dries it will be flat against the bottom of the piece.

This whole setup will need to be left overnight, or at least for a few hours before moving on to the next and final phases of the construction process.

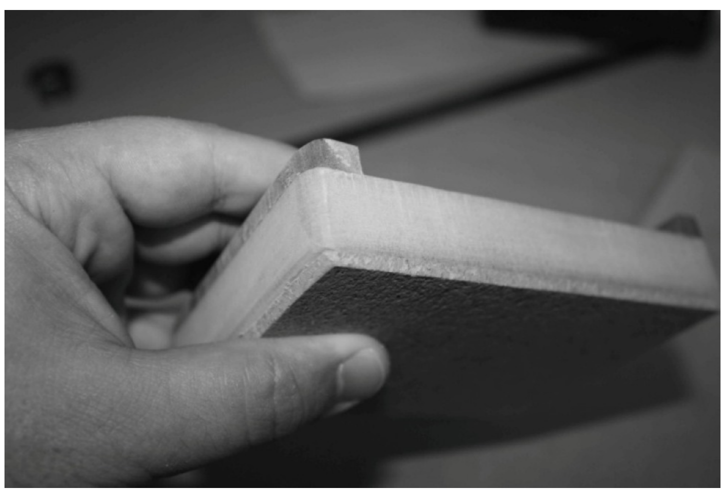
After the glue has dried for several hours or better overnight, remove the gym weights or whatever clamping method was used, and take a look at the piece. The cork should look flat where it makes contact with the sanding block, and the excess can now be removed.

Use a razor blade knife to carefully trace around the edges of the block, cutting off the excess cork. Be sure not to tear the cork as it is being removed, which can sometimes tear too much off, leaving chunks missing from the face of the block.

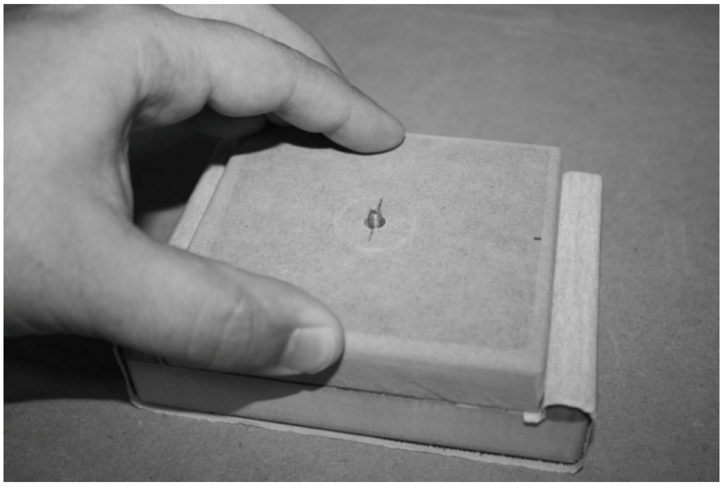
The sanding block should now look similar to the one seen in the picture above, with a cork layer glued to the face and the edges fairly rough from cutting. At this point it is easier to inspect the face for any bumps or lumps from the gluing process, which will mean that the cork will

have to be removed and re-done. A lumpy sanding block leaves lumpy wood behind when sanded, so make sure the bottom surface is flat before proceeding to the final few cosmetic steps.

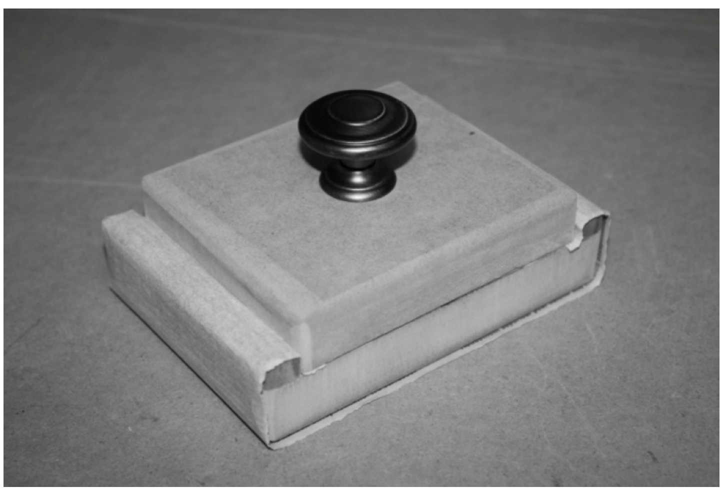
Use the belt sander again to bring the cork overhang flush with the edges of the block, and round them over slightly.



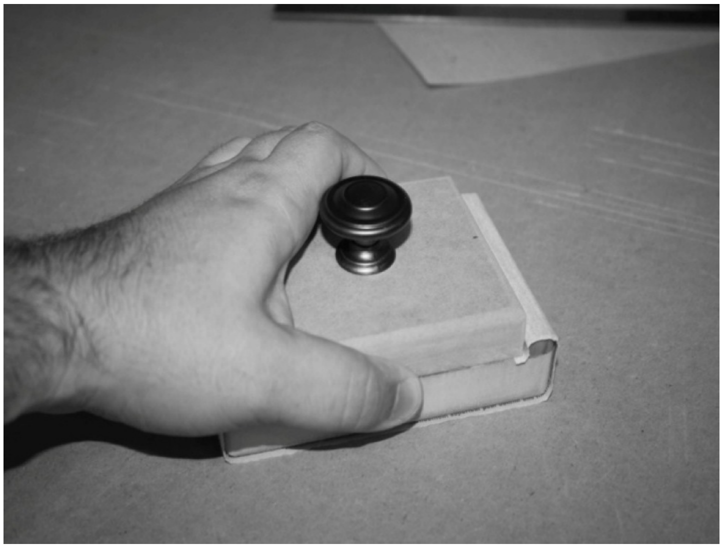
A slight breaking of the corners makes the cork less brittle in those areas, and makes it easier to use the sander.



Wrap the sandpaper around the tool and put the top block in place, pressing it snugly, to hold the edges of the sandpaper. The edges of the top and bottom blocks should line up perfectly now, and be a very smooth transition.



Screw the knob down to the top block, tightening it against the surface of the wood. Once the two blocks come together, only about a quarter to half a turn beyond that is needed. Any more force and the screw or the threading inside the knob may strip, which would mean building the block again. The pressure from the top and bottom blocks fitting together is all that is really needed to hold the sandpaper in place. The knob only acts to hold the blocks together, which does not require much pressure at all.

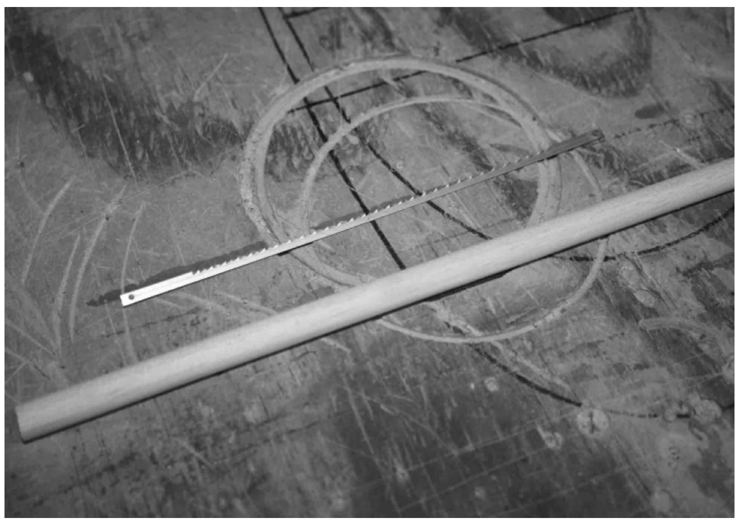


This is an extremely comfortable sanding block to use, and is sure to become a shop favorite in no time. Several of these can be made in different sizes to suit different sanding applications, or simply so switching grits is faster.

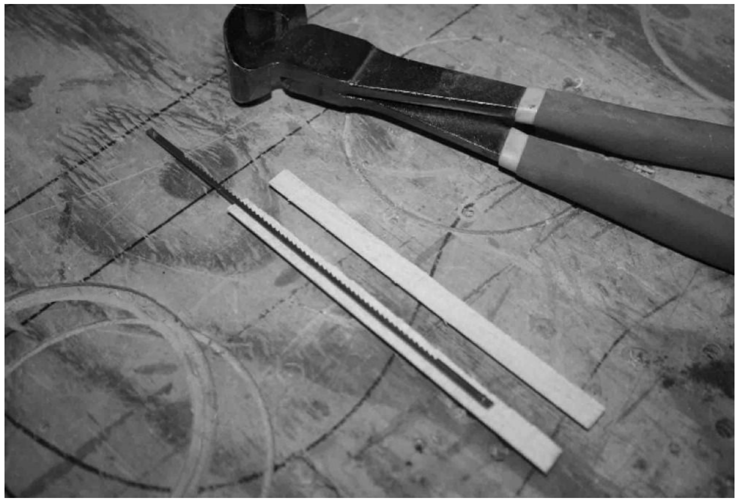
This sander can be made as elaborately as desired, though at least the bottom surface needs to be made from a very flat and well seasoned piece of wood. This way the sanding surface always stays flat, and will always be an effective sanding tool. If mere utility is the end goal, making the tool from MDF is the easiest way to get a truly flat sanding block that is easy on the hands, and will do the job well.

CLEARANCE NOTCH SAW

After the bridge pin holes are reamed to size, a small notch needs to be cut in the front of each hole that will give the string somewhere to sit without disrupting the pins. There are a number of ways to do this but a very simple way is to make a small clearance notch saw from an old scroll saw blade and a dowel rod. A jigsaw blade can be used as well, however there is a little more work that has to be done to it, which will be explained later on.



Find a medium toothed scroll saw blade, a 6" length of dowel rod at least 3/8" in diameter, some wood glue, and some heavy tape. Masking tape, duct tape, or electrical tape will all work fine.



Split the dowel open along its length using a band saw and lay it open on the workbench. The small pins on the one side of the blade will be pressed into the wood to help keep the blade in place. If the scroll saw blade does not have pins, do not worry about them, they are not necessary for a strong tool. Place the blade on one half of the dowel, leaving about 1-1/2" of teeth exposed on the blade.

Apply a layer of glue over both halves of the dowel, leaving the blade in place. Put the dowel together and squeeze the pins into the wood. A bar clamp may be used if this cannot be done by hand. Wrap the dowel

and blade in tape, making sure it is tight and that the part of the blade sticking out is in the center of the dowel.

Using a wire cutter or nipper, cut off the section of the blade that does not have teeth on a slight angle back towards the handle.

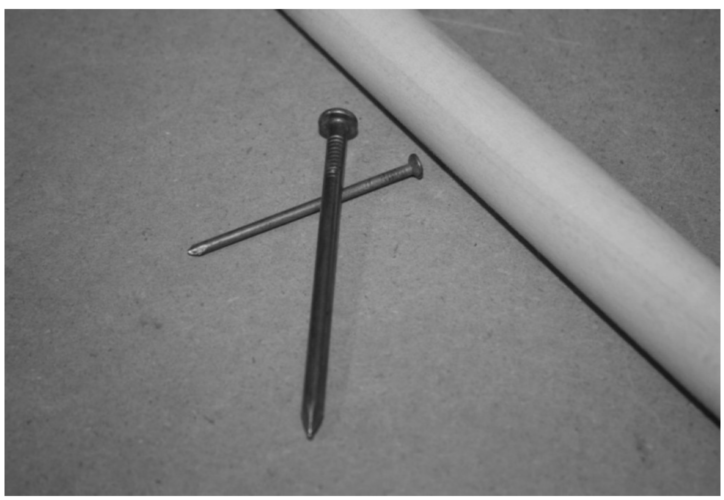
Make a couple of these with different width kerfs to handle the thicker and thinner strings. They are very quick to make and they will last forever.

If a jigsaw blade is the only thing available, the spine of the blade needs to be ground down to about the same thickness as the scroll saw blades in the picture, so they will fit inside the bridge pin holes. This can be done with a bench grinder or a belt sander. The rest of the blade can be wrapped and glued into the dowel like normal, though a larger dowel may be necessary to keep it all in. Scroll saw blades are cheap though, and even if they have to be purchased, it is still far less expensive than buying a pre-made tool.

EASY SCRATCH AWL

An awl is a useful item to have in the shop, and really helps the drilling process. The issue with many drill bits and drilling itself, is getting the bit started correctly. Once the bit breaks into the wood, it will go in that same direction very easily, it is getting the bit started that causes problems.

An easy way to help a drill bit as much as possible is to use an awl to make a divot for the bit to follow. These are sold in hardware stores but one can easily be made in the shop from a nail and a small scrap of wood. It will be easy then to get in the habit of using the awl to make an indentation where the drill bit needs to go, and the brad point of the drill bit can easily follow.



To make the awl, a steel nail will be needed, though in a pinch any construction nail will work as well. The reason a steel nail is asked for is because it will hold a point better than a standard nail, and will also be easier to shape on the sander.

Look through any old nails laying around in the shop. A steel nail will be brighter in color than a construction nail, and it will also be heavier when picked up. Many older nails were made like this, which was a time when people favored quality over price. These nails were strong, hard to bend even on accident, and would last a hundred years even out in the

elements. This kind of nail will make an awl that will be a part of the shop for decades.

For the hand grip, a length of dowel rod can be used to make a simple handle, or a piece of flat wood can be used as in the following description. Some two part epoxy will also be required for gluing the nail inside the handle, which will prevent it from coming out no matter how hard it is pressed into a piece of wood. It will also make the tool safer for the same reason, preventing it from breaking under the force required to use it.

Begin with the nail itself, and rotate it against a belt sander to smooth out and sharpen the point.

The process should remove any facets on the head, and smooth it to a nice sharp point. It does not have to be extremely sharp, but sharp enough to dig into a piece of wood easily.

Use a hack saw to remove the head of the nail once the shaping has been done, and discard the removed piece. Make the cut close to the nail head because the more nail shaft inside the handle the stronger the tool will be, and the less likely it will fail under pressure. Use a file to bevel the sawn end if there are any sharp edges that can cause injury to the hands while assembling the tool.

The first option for making a handle is to simply take a dowel rod that is an inch or so in diameter and mark the center. Drill out the center a little larger than the nail diameter on the drill press, and cut the handle to a comfortable length. While this is a great way to do it, a wider handle can be made from a thinner strip of wood, which is how these directions will proceed.

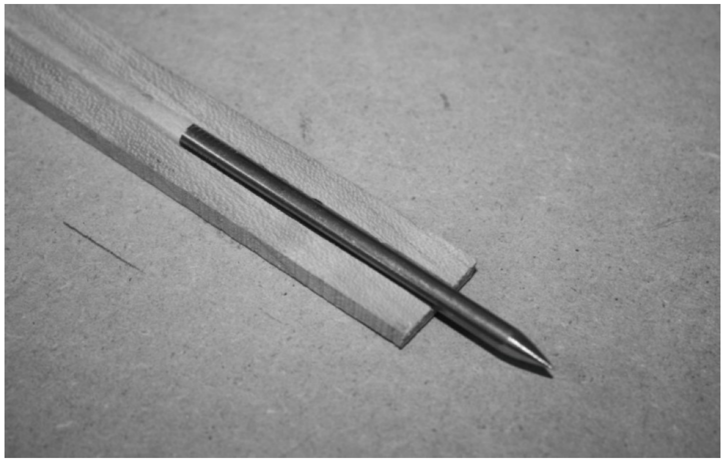
If making the tool handle from a dowel, the instructions will be the same with the exception of the handle looking a little different. Either way will work, and both will make an excellent awl.

Begin by cutting out a strip of wood that measures 1" x 1/4" x several inches long. A length of at least 8" will be needed to make a comfortable handle, though making a piece around 12" will make the process much easier on the router table especially.

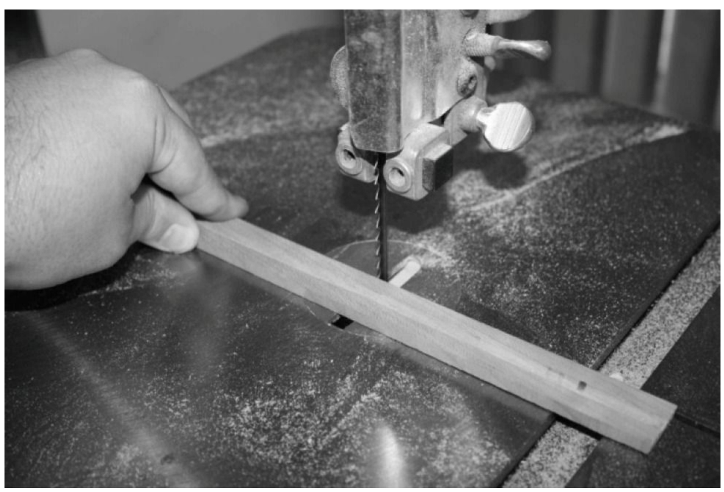
The wood can be any species as long as it is not cracked, warped, or excessively brittle. In this case the piece of wood seen in the picture above is cherry, and already cut to size.

Using a router table and a round nose bit, cut a semi-circle down the center of the strip, from end to end. Make sure that the bit does not go in any deeper than half a circle, which will be paired with another half later on in assembly, to make a complete circle.

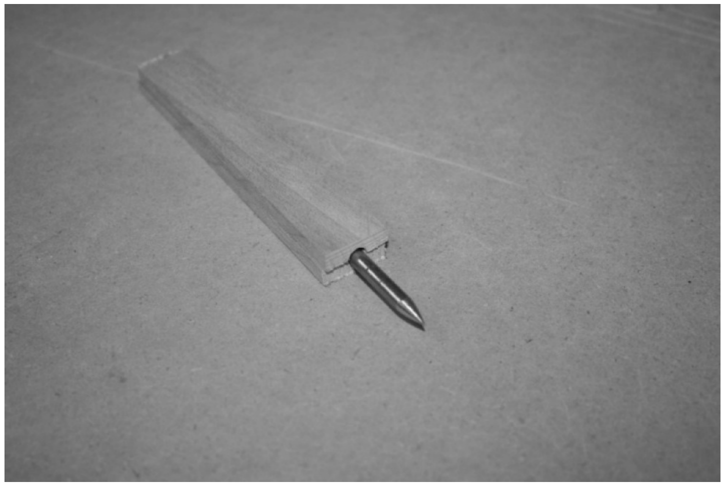
The edge of the wood will look like the picture above once the round nose bit has been through the piece. A half circle can be seen on the edge of the wood, and this will be where the nail is glued.



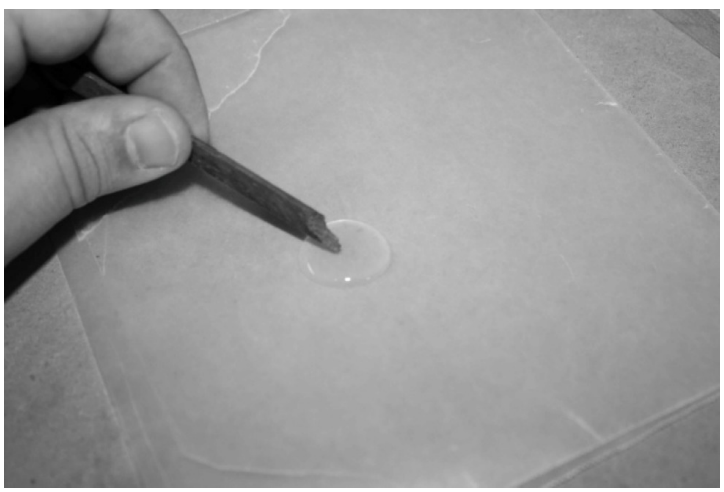
The nail can now be test fitted into the channel made by the router to see what the fit looks like. It should go in nicely, without a ton of wiggle room, but a little extra space is fine. Once the epoxy is in place, the nail will not be able to move at all.



Cut out two pieces for the handle, which in this case should be 4" long each. The band saw or the table saw are good options for this cut, though it can be done with a hand saw as well.

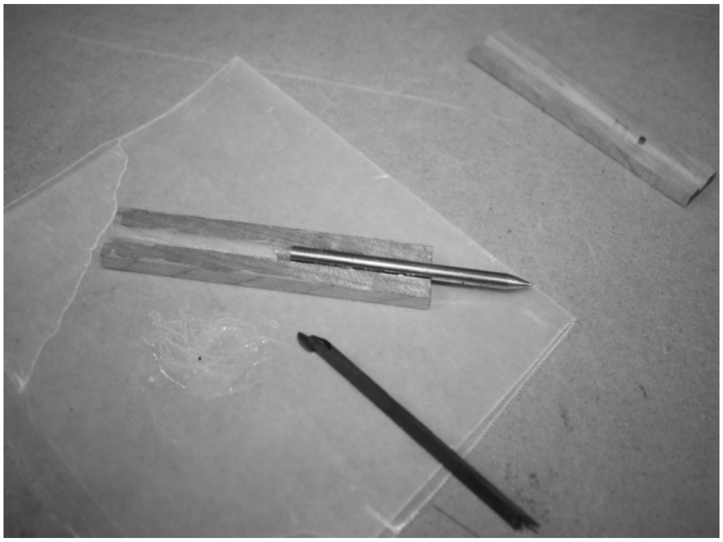


Test fit the nail inside both halves of the handle, and make sure that the wood pieces can come together and touch with the nail inside. This is important for gluing them together later on.

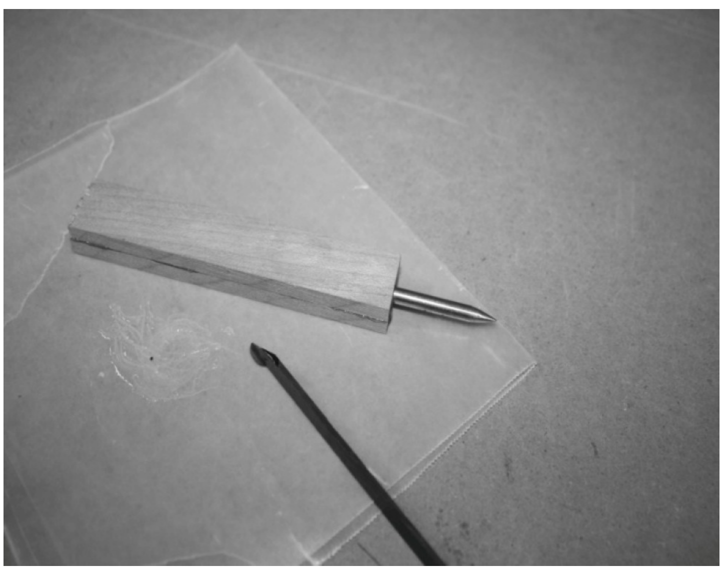


On a piece of wax paper, which will act as a disposable mixing tray, dispense a little bit of two part epoxy. Using a toothpick or piece of binding, thoroughly mix the epoxy together while on the wax paper. A good mixing means the bond will set up well when the epoxy cures.

A five minute epoxy is perfect for this project, and can be found in any hardware store. Look for a major brand when choosing the epoxy, as it will last longer and cure harder.



Epoxy can be used for gluing the whole tool together, including the wood to wood surfaces, so spread it all over the bottom piece. Once a nice layer has been applied, place the nail with at least half of the shaft inside the handle. In this case, a little more than half is inside, which makes the tool stronger than having more of it exposed.

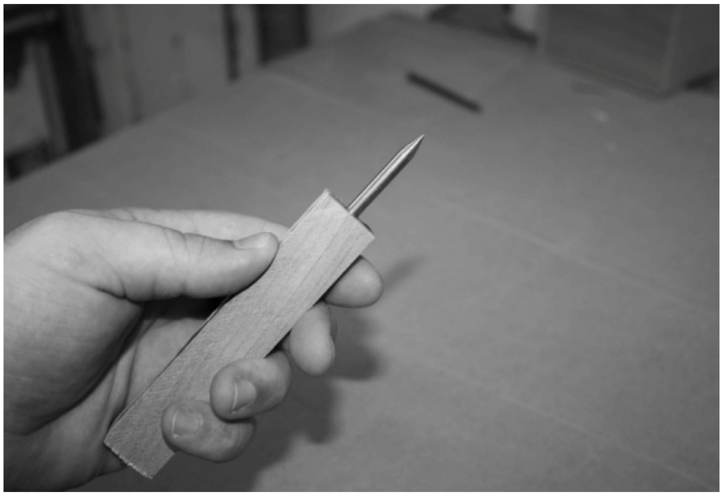


Place the top half of the handle over the bottom half, trapping the nail inside. Press hard and slide the top half from side to side a tiny bit in order to ensure the epoxy has been spread evenly on both surfaces. Do

not worry too much about any squeeze out, because it will harden like a rock and end up being sanded off later anyway.

Using the wax paper as a protective sheet for the workbench, lay a few weights on top of the handle, which will act as clamps. Gym weights make excellent clamps when not a ton of clamping pressure is needed, which is perfect for this case.

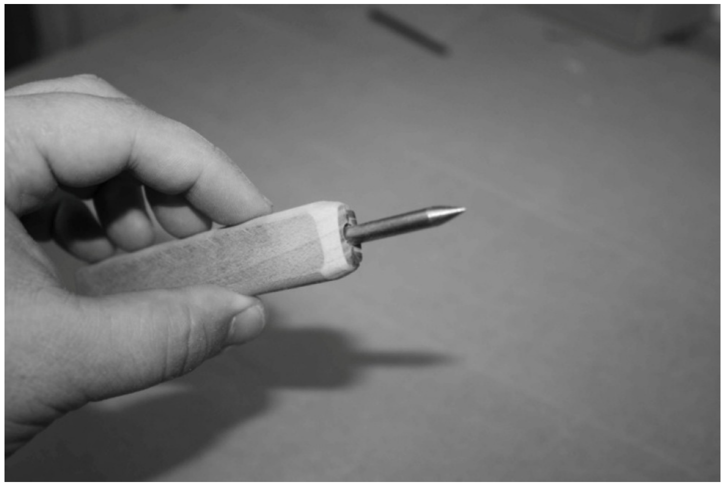
Allow the piece to cure for several hours in a room temperature place. Five minute epoxy takes only minutes to bond, however it will still take hours to cure and reach full strength. Do not stress the joint until several hours or better overnight, which will mean a stronger tool in the end.



After the epoxy has had ample time to cure, remove the gym weights and inspect the joint for any issues. If there are large gaps in the wood, they can be filled with more epoxy and allowed several more hours of curing. Also, check the nail itself to make sure it was glued in straight, and does not come out of the end at an overly large angle. It will be a matter of personal preference whether a little angle can be tolerated, though the tool will not really be any worse or better either way.

Once satisfied with the condition of the tool, it will need to be sanded and shaped better for a more comfortable grip in the hand. This will include removing all sharp corners, and a general sanding of the handle.

Use the belt sander to remove the bulk of the material, and getting the rough shape of the piece accomplished. Switch to sandpaper in the hand for the final shaping and smoothing.



With the edges rounded over and the tool sanded nicely, it is ready to be used as-is, or it can be finished with Tru-Oil or linseed oil. A couple light coats with a few hours in between for drying will do the tool well, and make it look more professional.

If an even more well made look is desired, the tip of the awl can carefully be buffed with tripoli until it shines with a mirror finish. The tip itself will need to first be sanded carefully to 320, to remove most of the scratch marks, but then it can be buffed with amazing results. Make sure to use a dedicated wheel for buffing metal, as it will make the wheel extremely dirty, and it will not be suitable for using on wood ever again.

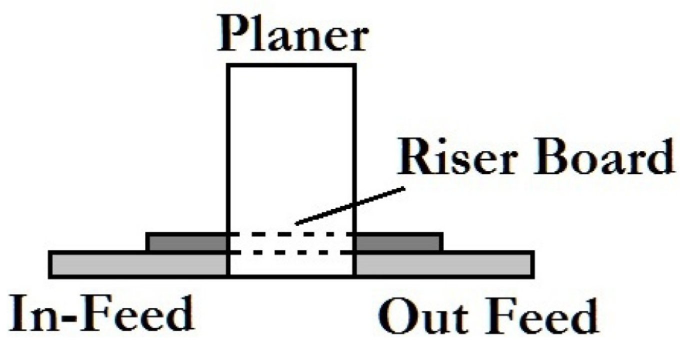
To use the awl, mark a board with two perpendicular lines that represent where a drill hole will need to be made. Place the point of the tool on the intersection of these lines, and stand it up vertically before applying pressure. This pressure will cause the tip of the awl to break through the surface of the wood right where the drill hole needs to be, making the drilling process go more smoothly.

THICKNESS PLANER RISER

Most thickness planers have only one real short coming. They cannot get the planer blades close enough to the base to make wood thin enough for some guitar parts. Top plates can sometimes be as thin as 0.085", and sides are routinely less than 1/8" in thickness. Planers will typically get down to about 3/16", then they will not crank down any further. At this point, many guitar makers take their wood over to the drum sander, or finish planing them by hand. Both of these methods will work but they take a large amount of time, or another expensive tool.

A planer riser is a piece of flat wood (MDF is the best for this) that goes in the planer and raises the base up a little bit. This extra 3/4" lets the planer go all the way to the base and then some, which means super thin pieces are now possible with that same planer.

The piece needs to be as wide as the planer base, and long enough that it can be clamped to the in-feed and out-feed trays with bar clamps. The piece must also be thick enough not to bend or move while the machine is running, or bow from the clamping pressure. A piece of 3/4 MDF is perfect for this job because it is strong, and manufactured completely flat.



Cut the board to the proper dimensions depending on the planer it is being made for, and clamp it down to the base. Bar clamps placed on the outside edges of the in-feed and out-feed secure it in position, just make sure to keep them clear of the wood that will be passing through the machine.

Another creative approach to using the planer riser is that it can be made to match the final thickness for a certain guitar part. For example, most backs are planed down to 1/8" thick. If the riser board is first planed down to 5/8" by passing it through the machine, setting the depth stop at 3/4" will mean a gap is left of exactly 1/8". This cuts out all of the measuring and checking of the pieces with a dial caliper after each pass. It makes it so that when the plane is set to a certain size the piece that comes out is exactly the right thickness every time.

The sides and tops can have a special riser plate made for them as well, so that once the plane hits the depth stop, the resulting sides are always the right thickness.

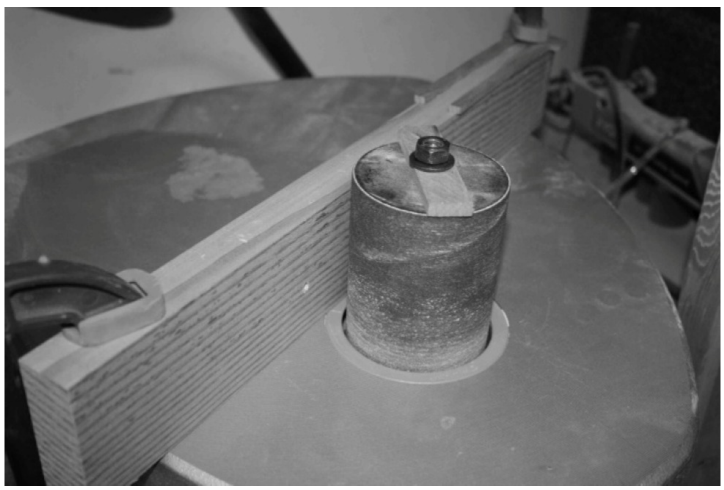
Project Notes:

An important thing to check for when planing wood is that there are not any nails, staples, or other metal objects in the wood. It is not uncommon to have staples from price tags, nails if the wood was reclaimed, or other small metal items stuck in the wood. When these hit the planer knives they can ruin them, and the piece can possibly be turned into a dangerous projectile.

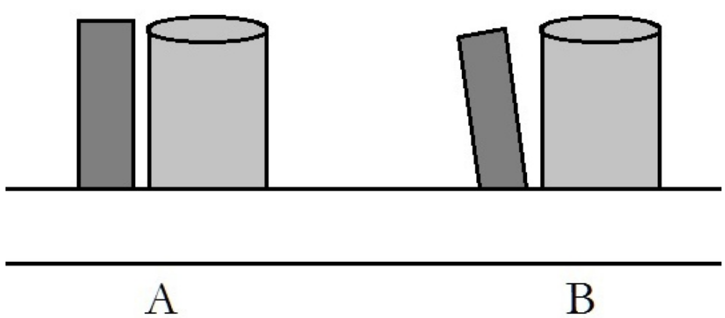
Do a visual inspection of any wood that is going into the planer, and remove any metal items before it goes in. Some things are not going to be visible, like buckshot or other metal that was embedded into the tree while it was alive. However, there are metal detecting wands that can find those too. Depending on how much wood will be sent through the planer, it may be a wise investment to purchase one.

SPINDLE THICKNESS SANDING JIG

A spindle sander can be used with a simple to make jig to function as a small drum sander. Though the spindle sander will not be able to handle large pieces like tops and backs, it will easily be able to thickness small items like binding, bridges, and fretboards. A similar jig can be used in the drill press, however the up and down action of the spindle sander keeps the sandpaper from loading up as quickly.



The basic version of this jig is simply a piece of flat wood clamped in place next to the sanding head. This fence needs to be as tall as the piece being sanded, and have a well jointed bottom edge.

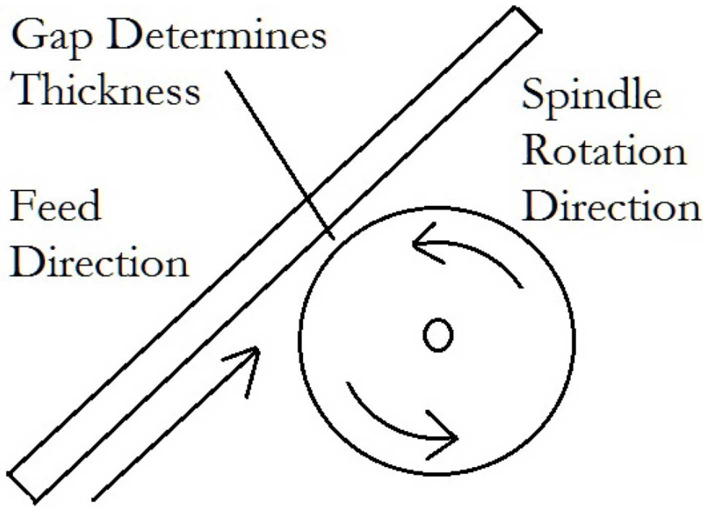


The above image shows the importance of having a well squared bottom edge on the board being clamped to the table top. The face that is near the sander and the edge being clamped against the table top must be square to each other, or the piece will be sanded unevenly.

Diagram A shows a very square board, and the gap between the sander and board is the same size on the top as it is on the bottom. This will produce evenly sanded boards when used.

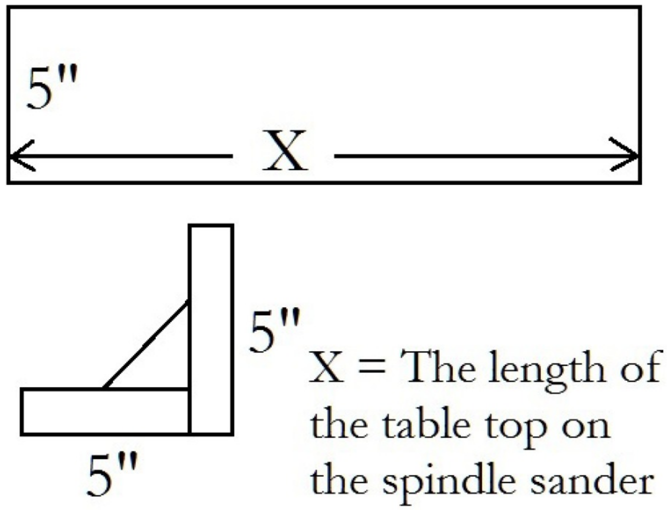
Diagram B shows an exaggerated version of a poorly squared board, and the uneven gap that results from using it.

A close up of the spindle shows that the gap between the board and the sander is what determines how thick the resulting pieces will be. It is important to take several passes over and over to remove the material. Each pass should only sand around 1/64" off of the surface or less. If a large amount of material needs to be removed, try getting rid of the bulk by either using the planer or a hand plane. The sander should be mainly for final smoothing or small amounts of material removal.



The feed direction is another important consideration when making a spindle sander into a thickness sander. The pieces must be fed against the rotation of the drum, otherwise it will be thrown across the shop and destroyed.

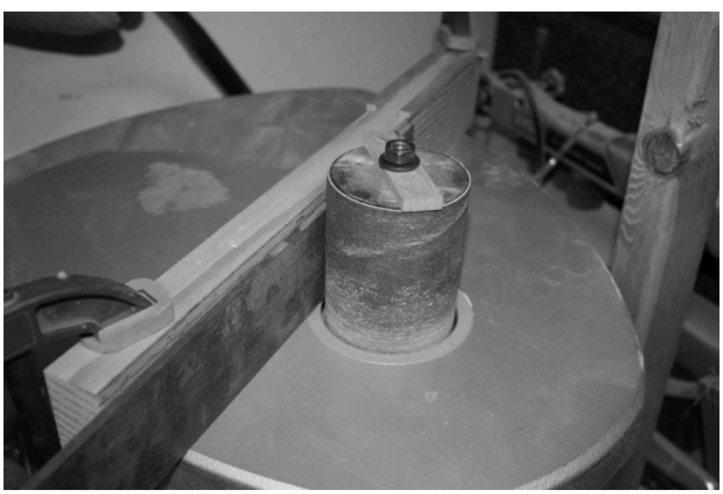
The spindle rotation needs to be checked before the jig is built, making sure that the fence is being put on the correct side of the head. With the rotation against the piece, it forces the wood against the fence, helping to create evenly sanded pieces exiting the jig. It also prevents too thick a pass from being taken because a really thick board will not be able to be forced through. The rotation makes it so the board will have to sit against the sander until enough material has been removed that it is thin enough to pass by. When a board will not pass between the sander and the fence easily, it is a sign that the fence is too close to the sander, and needs to be moved out a little bit.



If the spindle sander is something that is going to be used a lot as a thickness sander, it is a good idea to make a small fence that can be used each time it is needed.

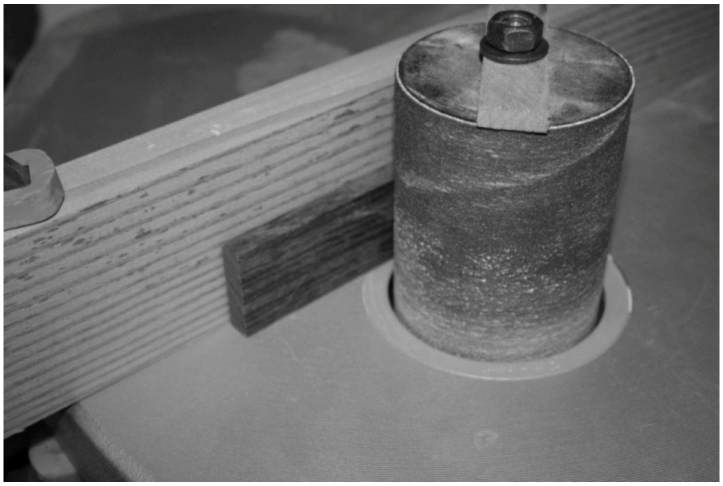
Use a piece of MDF or plywood, and create a 5" tall fence that is as wide as the table top on the spindle sander. Glue a piece on the bottom edge, creating a L shape, and reinforce it with triangles of wood in a few places along the back side.

When gluing or screwing this together, check the piece with a square a few times along the way to make sure it is square to the table top.

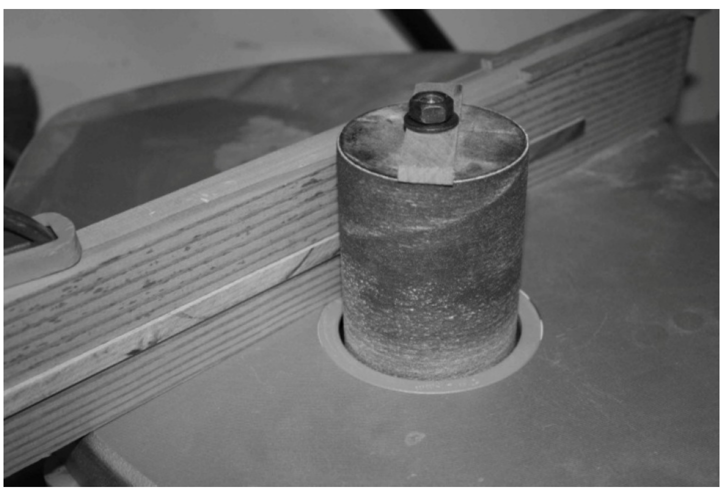


The spindle sander thickness jig can be used for many things around the shop. The above picture shows a fretboard being sanded to

thickness easily with a few passes. This will create a more level and uniform surface than when sanding by hand, and much quicker too.



Bridges are another piece that can benefit from being sanded flat in the spindle sanding jig. It is always a good idea to start with flat and square material, and the bridge is no exception. These can be sanded by hand, but again the spindle sander is faster and more accurate.



Project Notes:

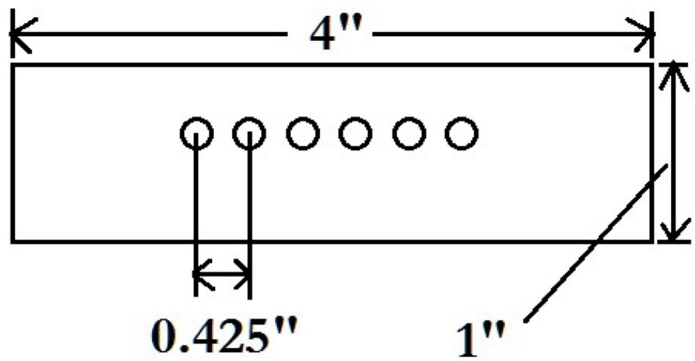
One of the best uses for this jig is definitely for making binding strips. If the strips cannot be cut thin enough on the table saw,

they can easily be refined here on the spindle sander. Only one side needs to be sanded, since the side facing out will be scraped level anyway.

Set the sander to a thickness that removes a little material from the freshly cut strips. Then, send each strip through the sander one at a time, keeping the sanded sides facing one way when they are set down. Adjust the sander a little thinner, and send the pieces through again, making sure the same side is being sanded. If a third pass is needed, make a third pass the same way, sanding every piece one at a time until they have all gone through. This will guarantee that all the pieces will be the same size once they are done being sanded. It also saves time by not needing to reset the fence.

BRIDGE PIN DRILLING GUIDE

The holes for the bridge pins are somewhat difficult to drill evenly without a guide. Since the bridge is the focal point of the guitar top, an error here will be easily seen. A simple guide can be made from a piece of really hard wood, that will keep the holes aligned right, and keep the spacing even. This does not need to be made from metal, though it would last almost forever if it were. The piece of purple heart used for the jig in the pictures has lasted through many guitars and is still in use.



The best way to determine the placement of the holes to be drilled is to break it down using math. A string spread of 2-1/8" or 2.125" means there is a distance between each string of 0.425". A dial caliper that goes down to thousandths is the easiest way to transfer this information, and can be purchased somewhat inexpensively for a non-digital model. The caliper can also be used for many other guitar related tasks.

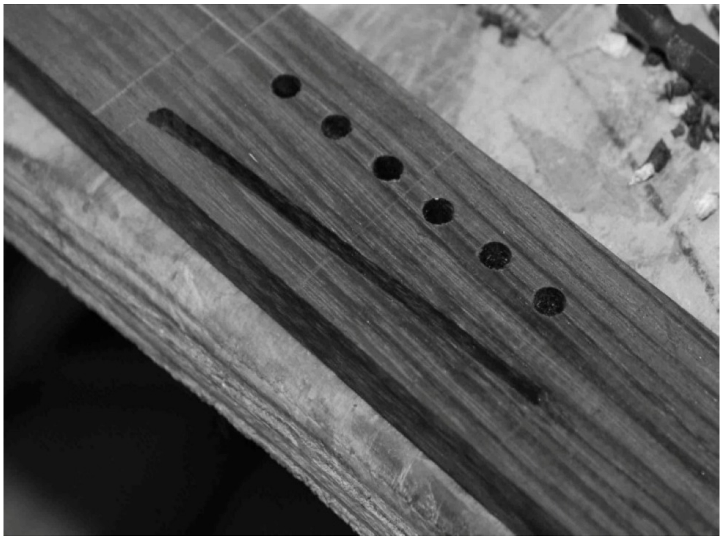
The piece of wood for the guide needs to be a very hard wood, like Purple Heart or Lignum Vitae, so that the drilling does not widen the holes over time and make the guide inaccurate. Cut a piece at least 1/4" thick, 1" wide, and 4" long, and draw a straight line about half an inch from the 4" edge. This line will be where the holes are plotted, and in the picture would be going from left to right and through the centers of all the holes.

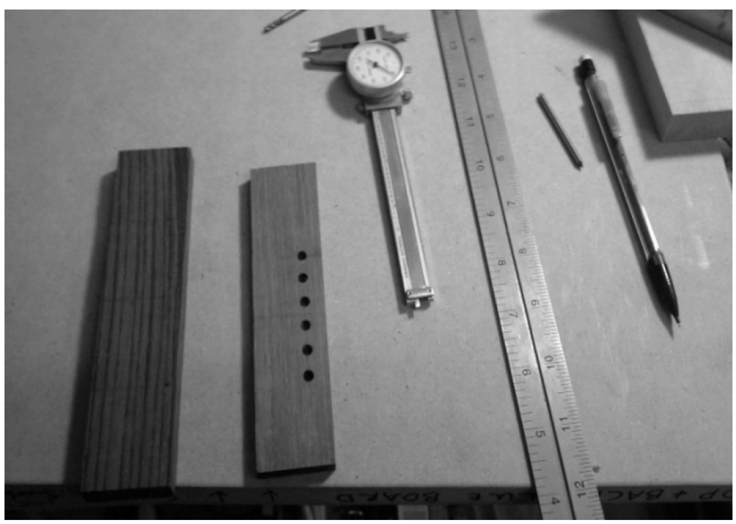
Using the dial caliper, mark the points where the holes will need to be drilled. Again, they should be 0.425" apart from each other. The best way to do this is to always measure from the first point, and make a mark on the line. Do not measure from anywhere other than the first mark, because if some of the marks are wrong, then the rest of the marks after will

be wrong too. Always go from the first point, and mark out the other five. Once they are marked, use an awl or the brad point of a drill bit to mark the center for the bit to follow. This little indent gives the drill bit a place to start, and reduces the chance of it moving around.

Use a 3/16" brad point drill bit to drill the holes, and it is also best to use a drill press to make sure the holes are square. Take time with this, because if the guide is drilled wrong, all the bridges made from it will be wrong too. After it is drilled, check it for accuracy using the dial caliper. If it looks good on the caliper, clamp it on top of a piece of wood and drill the six holes with the same 3/16" brad point bit. Remove the guide, and look at their alignment. If they were drilled well, they should be in a perfect equidistant line.

To use the guide, mark a line with a pencil on the top of the bridge where the pins will be drilled, and make two more marks where the outside two pins will need to be. Place the guide on top of the bridge and line it up so the marks can be seen through the holes in the guide. Once satisfied that the guide is placed well, clamp it down with two strong clamps.

Check that the guide is still in the same place after clamping, and drill the holes using the 3/16" brad point drill bit from earlier. Remove the guide and check the accuracy of the holes. Since the guide was built correctly, the holes should also look very straight and even.

After the holes are drilled, verify them with the dial caliper and by eye, that they look correct and are the right distance from each other. If they are, the guide is accurate and can be kept for future use.



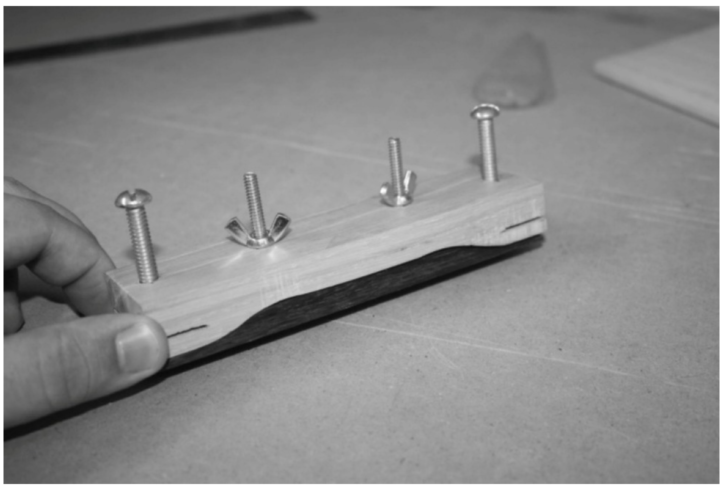
There are steel bars sold in hardware stores that would also work well for this project. They are mild steel, so drilling them is not much more challenging than drilling wood. The trick with metal is to slow down the drill speed if possible, and back the drill bit off many times to cool it and to clear out shavings. When a drill bit gets too hot, it loses its temper and can dull quickly. Once it is dull, it will be almost impossible to drill six accurate holes with. If this is going to be made from metal, it will be worth

it to pick up a special 3/16" bit that is designed specifically for drilling metal.

The layout process is the same for metal as it is for wood, and the drilling is best done on a drill press rather than a hand drill. If the same bridge pin spacing is going to be used indefinitely, it is well worth the effort to make a metal drilling guide. A metal guide should last forever if taken care of and used carefully.

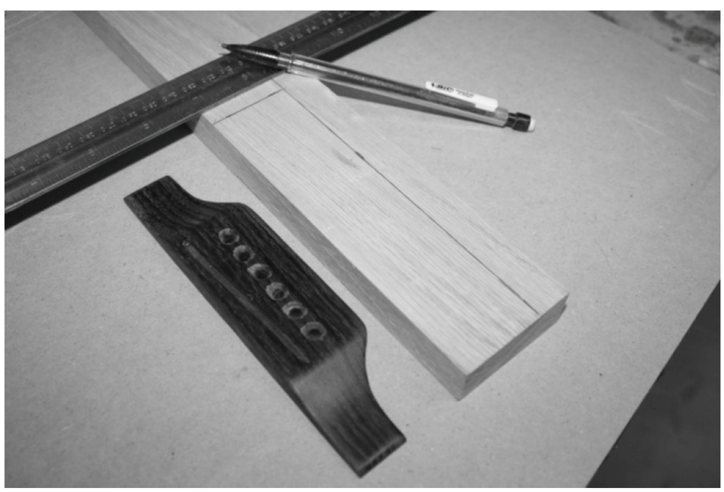
BRIDGE CLAMPING CAUL

If cam clamps are not available, or are not the correct length to be used through the soundhole, a simple wooden caul can be made and used with a few screws to hold the bridge while the glue dries. It can be made from scraps around the shop, and a few machine screws, and will effectively clamp the bridge to the soundboard.



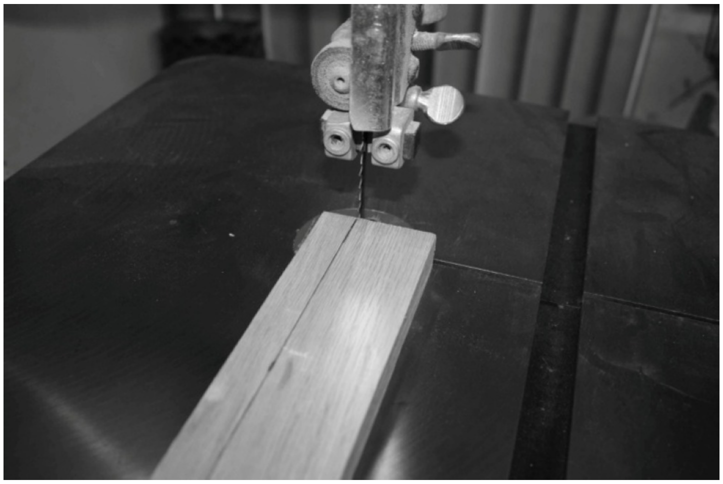
The tool itself if a piece of wood that is sawn and sanded to the same profile as the bridge, and a set of screws with wing nuts pass through the bridge and secure it to the soundboard. The machine screws on the outside ends are used to press down a flap of wood, which ensures that the wings of the bridge are also tightly against the soundboard.

To make the clamp, a finished bridge will be needed in order to size the clamp correctly. A pair of 10-24 screws measuring at least 1-1/2" long with wing nuts will be needed, as well as a pair of 1/4-20 screws that are one inch long. Since the first set of screws mentioned are going to need to pass through the bridge pin holes, make sure to get the size recommended, because anything larger will not fit. The caul portion of the tool can be made from scrap, though due to the clamping requirements a piece of Maple or Oak are the best choice. The piece needs to be 4/4 thick or thicker if desired, and measure at least the same width and length as the bridge it is being made for.

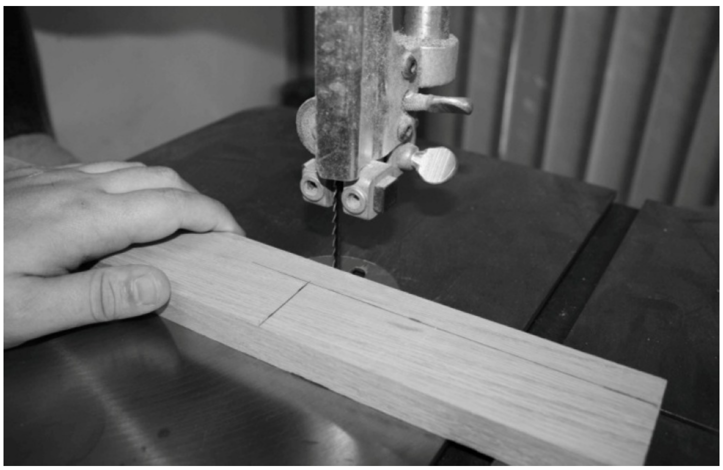


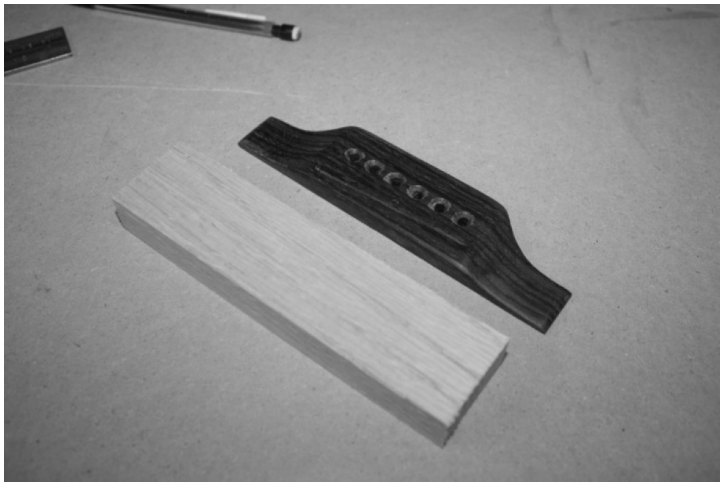
Using a ruler, measure and mark out the dimensions of the bridge onto the piece being made into the caul. The measurements of this

caul are going to be 1-1/2" x 6", which is easily cut from this piece of Oak. Make the lines dark and easy to follow while sawing.

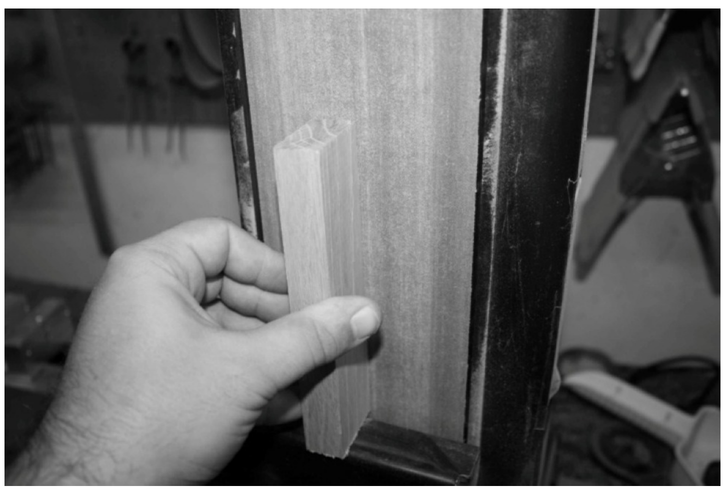


On the band saw or table saw, cut out the piece carefully, making it as straight as possible.



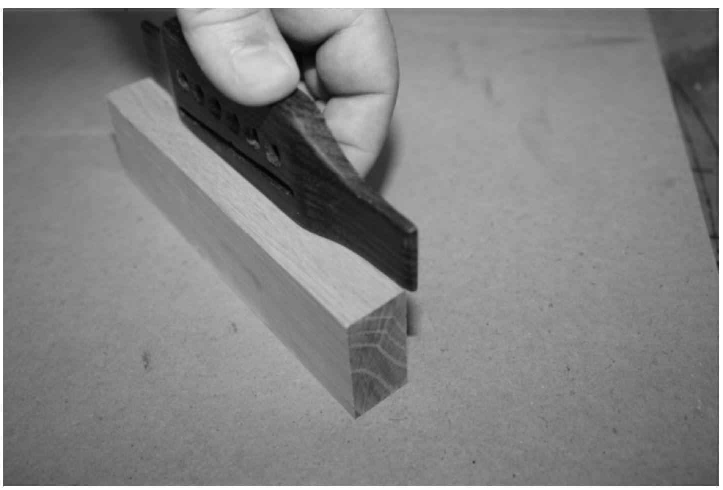


Once the piece is sawn out, check it against the bridge to make sure it is the same size, then proceed to sanding the edges.



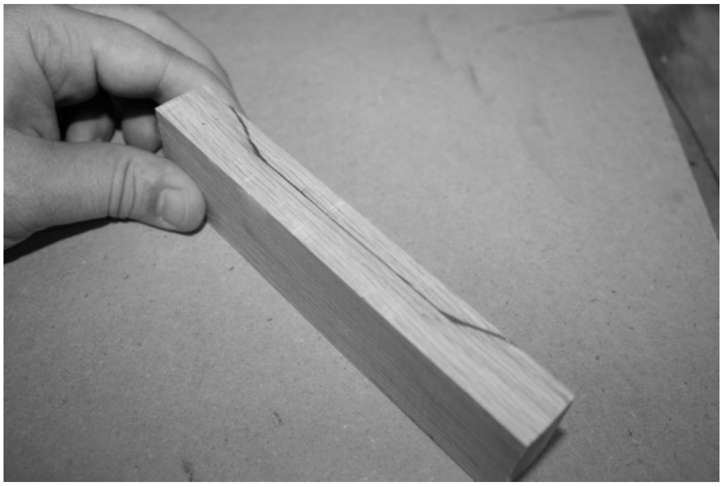
On the belt sander, sand the edges that have been cut with the saw in order to smooth them out. A belt sander will be quicker, but sanding by hand with a block behind the paper will also do the job.

The reason to sand the edges is so that any splinters are removed, and so the piece looks nicer overall. There is no reason not to treat a tool being made in the same way the guitar will be treated.



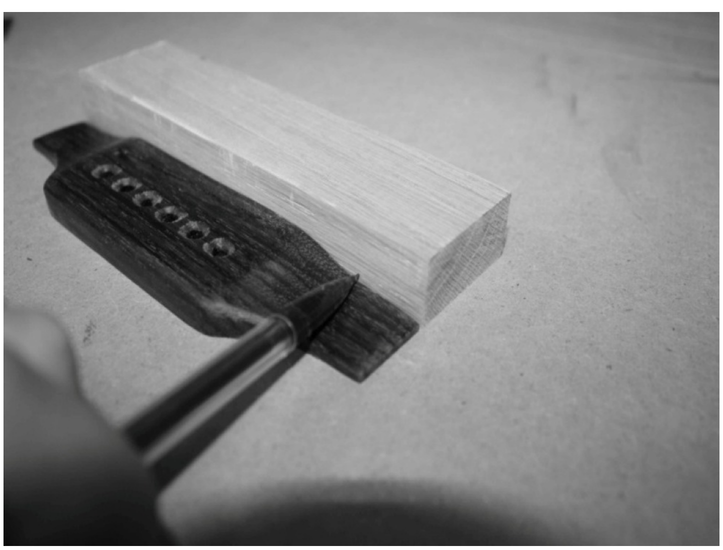
To get the profile of the bridge exactly onto the piece of wood, the bridge will need to be held against the edge of the wood as seen in the picture above. The wings of the bridge are touching the edge of the board, but only the hump in the middle is actually extended over the edge. The reason for this is to preserve the piece of wood by not reducing the thickness any more than in the middle.

Draw a pencil line around the center hump of the bridge, tracing the profile onto the edge of the wooden piece.



The line that is left once the bridge is removed should look like the picture above, again notice how the wings are not a part of the area to be carved out. The center portion will need to be removed on the band saw and then refined on the belt sander later to make sure it is a smooth surface and a good fit.

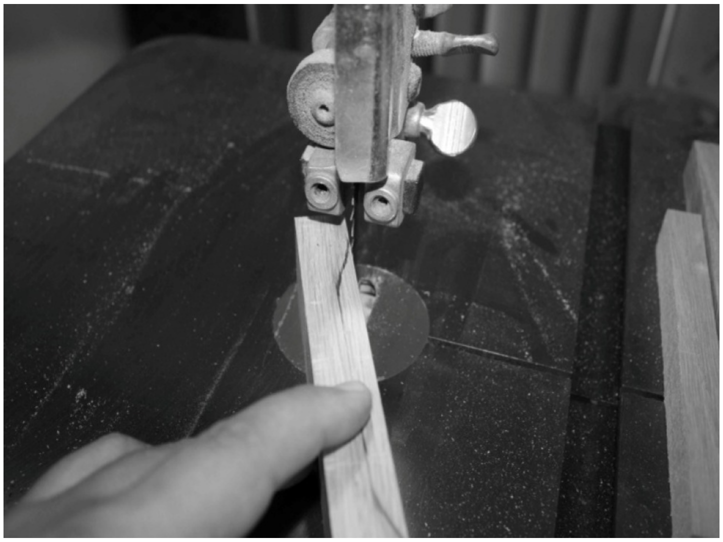
If the piece of wood being used is a little thicker, another method of tracing the bridge can be done. On a piece that is 4/4 thick, preserving a little more wood is necessary, which is why it is done this way in the example. However, if using a little thicker piece of wood, the entire profile of the bridge can be laid out on the edge before cutting, as will be seen in the following pictures.



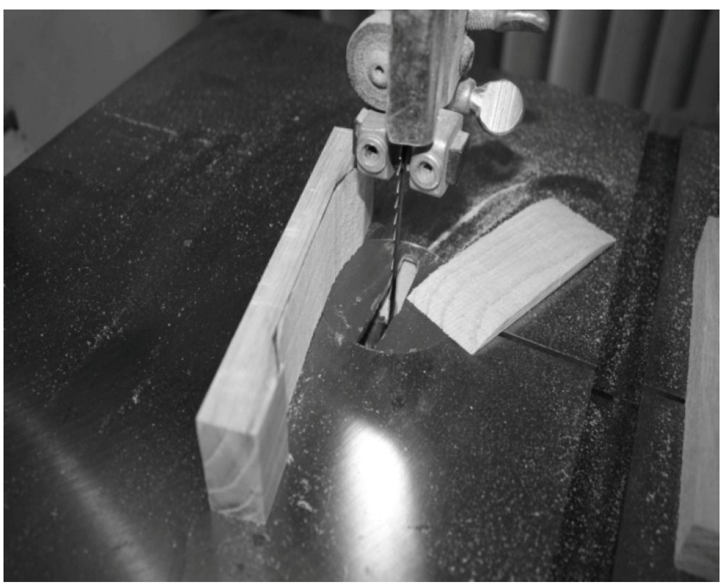
Lay the bridge down next to the wooden caul and trace a line that follows the profile very closely along the edge. This line will serve as the reference for carving the waste wood away, and needs to be as accurate as possible. On a thicker piece of wood, the extra that is removed by doing it this way will not remove so much that the mini screw clamp can still be made for the wings.

With the bridge taken away, the profile can easily be seen, and the line followed when cutting and sanding later on. Notice how this piece is now much thinner on the ends due to the area around the wings being removed as well. It effectively lowers the thickness of the caul by around 1/8" or more, which in the case of 4/4 wood is too much.

Either way the profile is drawn on the side of the piece of wood, the important thing is to leave enough thickness (4/4) in the bridge wing areas to make the screw clamps. It is also important to get the line placed very accurately, because it will reduce the amount of sanding and filing that will need to be done later in order to get it to the correct shape.



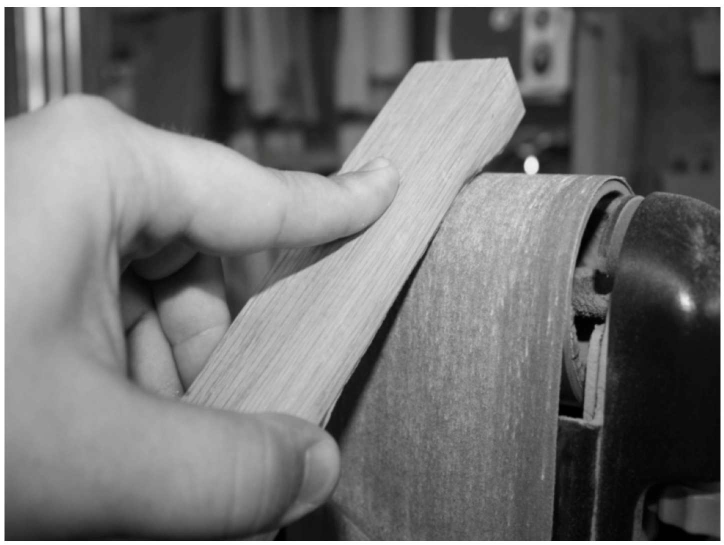
With the line drawn on the edge of the piece, bring it over to the band saw or jig saw and cut off the waste portion. The band saw is truly the best tool for this process, though it could be done by hand with a coping saw. Take care not to go over the line and into the area that will be kept, because this will make the caul less effective of a clamp.



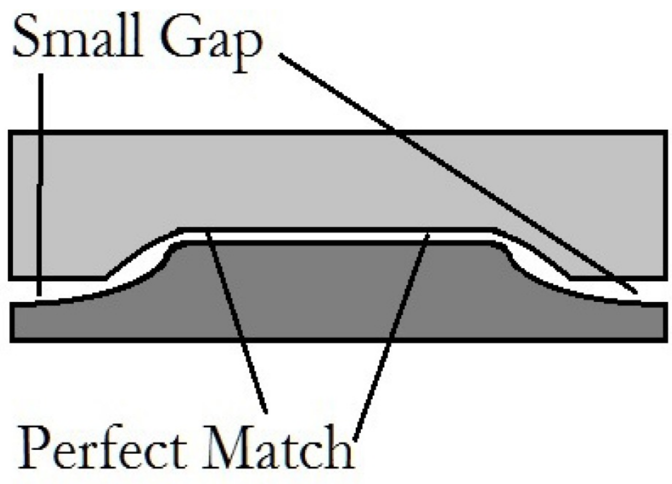
With the waste portion removed, the piece is ready to be taken to the belt sander and the saw marks sanded off. If time is taken on the band saw, a cut can be made that is very clean and close to the line. This will

reduce the amount of sanding that will have to be done, and make the process go smoother.

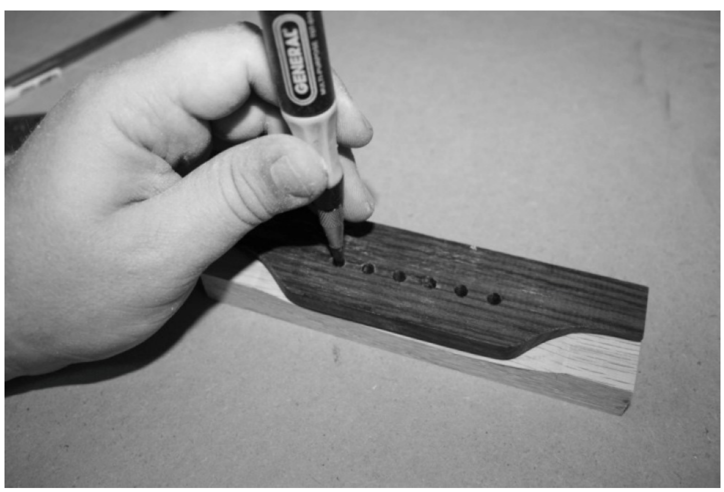
If a coping saw is used, make the entrance cut a little inside the line in the waste area, and work the saw towards the cut line without going over it. Pay attention to the angle of the saw while working, and take breaks from time to time to ensure that the saw is always at a 90 degree angle to the piece. It is not impossible to make this cut by hand, though it will be a longer process than doing so with a power tool. If done patiently, it will work out well either way.



Sand the piece on a belt sander or a spindle sander, being careful not to remove any wood past the line made earlier. The reason the piece is sanded is to remove any saw marks, as well as refine the surface to be a perfect match for the bridge. Check the caul against the bridge itself a few times, to see how progress is going, and to ensure the right areas are being sanded. Once complete, sand a little off of the wing areas only, to make a small gap when placed on the bridge again. This will give a tiny bit of room for the screw clamps to operate, as well as allow this caul to be used with several bridges that are all around this same size. The sanding should remove around 1/32" of wood, and leave a small gap over both of the wings.



The diagram above illustrates the small gap that is needed over the wings, in order to make the screw clamps work later on. The sharp corners should all be rounded off, which is not the case in the diagram, which is slightly exaggerated in order to show the gaps over the wings. The important thing is that the hump of the bridge sits against the caul flush while the small gaps only exist over the wings. This way when bolted to the soundboard, the screws will apply a clamping action that firmly presses the bridge against the wood for a good glue joint.



Flip the caul over so the curved side is facing up and the flat side is laying on the bench. Place the bridge over the caul upside down, and line it up evenly on all sides. Use a sharp pencil or an awl to make a couple

marks on the caul for where the two screws will be placed. These will be inside the high and low E holes, which are the farthest apart on the bridge.

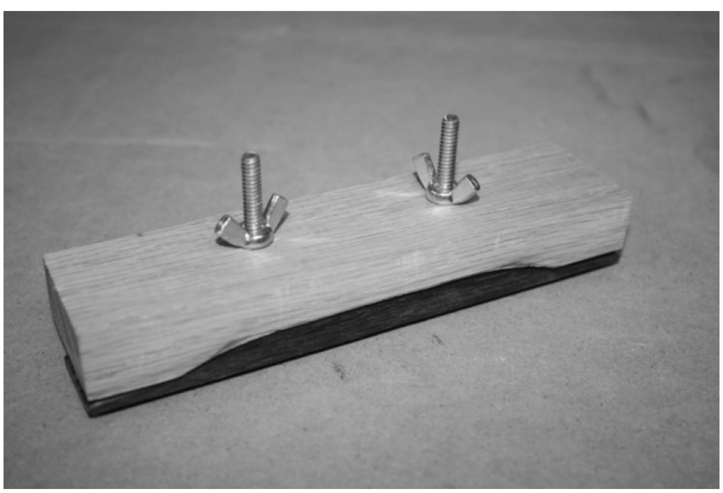
Remove the bridge from the caul and use a pencil to darken the lines, or the awl to widen the mark slightly. This will make it easier to see and easier for the drill bit to follow.

Chuck a 1/4" drill bit into the drill press, which will allow a little bit of clearance through which the screws can pass. Drill two holes into the caul, being careful to keep them aligned well. A brad point drill bit will help with this process, as they tend to go in the direction they are driven without wandering.

The 1/4" drill is used because it is slightly larger than the 10-24 screws which are going to be the clamping bolts. These screws are perfect size to fit through the 3/16" holes drilled into the bridge, which is why they are required for the bridge clamping area.

Place the caul over the bridge again, and lift it up to check if the two holes in the ends of the bridge can be seen through the caul. If they can, the holes were drilled well and the process can continue. If a small correction is required, drill out both holes a little wider, which should fix the problem. If a couple drill sizes bigger does not correct the alignment, it will be necessary to construct the piece again.

Be sure when lining up the holes that the caul is placed on the bridge in the same way that it was when the screw holes were drawn. The holes will be close to center, but not exactly, so having the caul placed correctly is important for verifying the position of the holes.

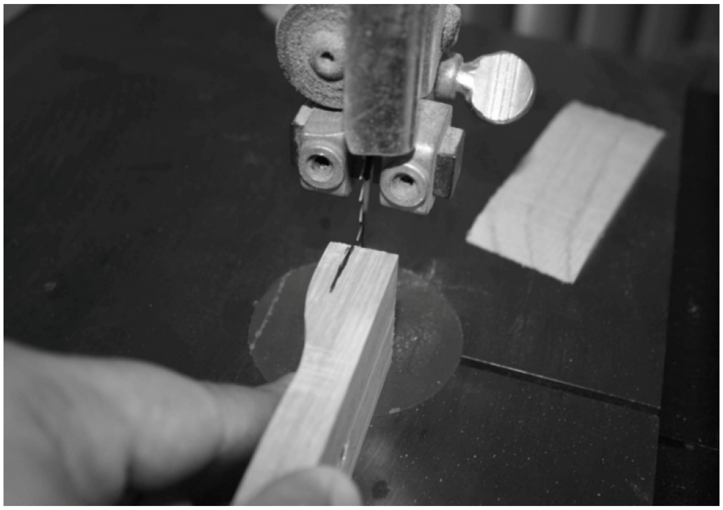


If the holes look good, try sending the screws through the bridge from the bottom and then sliding the caul on top. If everything was done

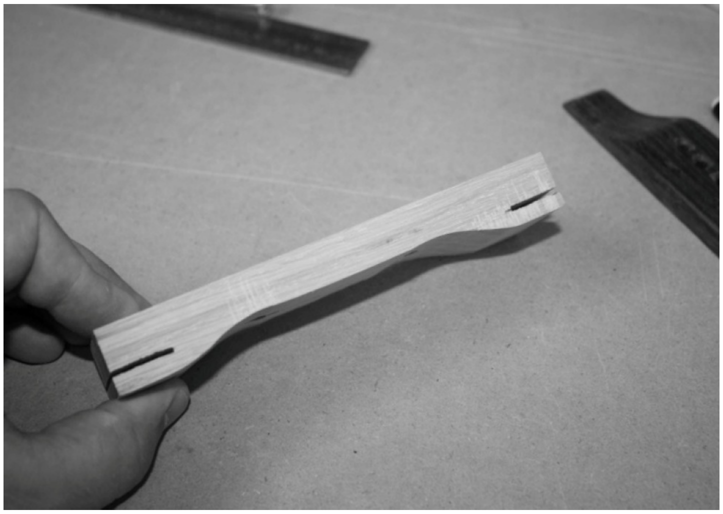
correctly, these two pieces should fit together well, and the screws should glide through without any resistance.

Screw the wing nuts all the way down and apply a little pressure with the fingers to snug them up against the caul. Doing a dry run like this early in the process ensures that there will be no surprises that pop up later on. A mismatch here can be addressed and corrected before any more work is done to the piece, eliminating lots of frustration.

To make the screw clamps for the wings, measure and mark a line that is 3/4" long and 1/4" from the bottom of the caul.



Cut through the line on the band saw, making as straight a cut as possible, stopping at the end of the mark.



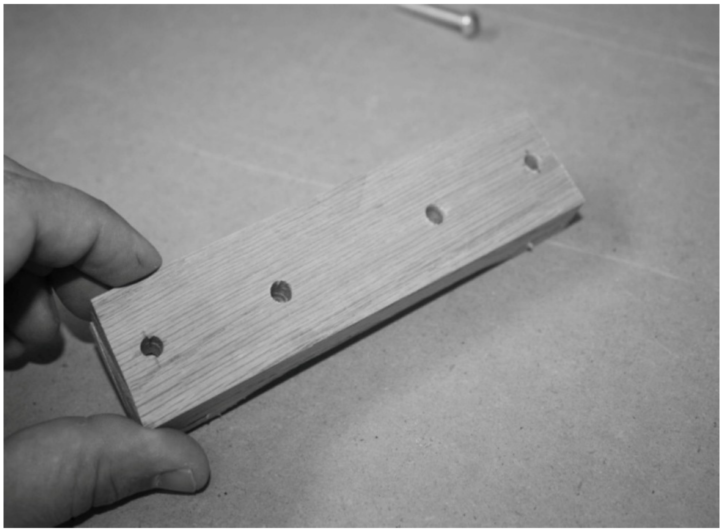
The piece should look like the picture above, with two cuts going into the ends and stopping before they get too close to the inside edge of the wood. They will not need to flex very much in order for the clamping to be effective, so they will not be stressed enough to break under normal circumstances. Inspect the cuts, making sure they are even on all sides, especially if they were done by hand.

Measure and mark the center of the caul, as well as another mark that is 1/4" from the end. The intersection of these marks is where the drill holes will be made for the machine screws that will drive the wood flaps downwards, clamping the bridge wings.

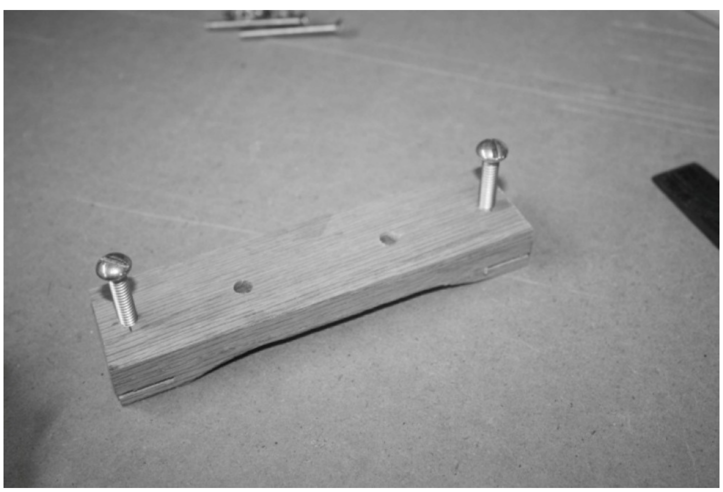
Make these marks with a pencil, and then come back with an awl or a sharpened nail and make a small depression for the drill to follow.

Set the depth stop on the drill to just where the bit will scratch the top of the lower piece but not go into it. If a depth stop is not a part of the drill press being used, or a hand held electric drill is being used, stop when the drill goes through the top piece only. When breaking through a piece of wood with the drill, a tell tale crunch sound is made. If this is listened for while drilling the holes in the caul, it will be very easy to know when to stop drilling.

These holes will need to be drilled with a 15/64" drill bit, which will make the holes just sung enough that the 1/4-20 screws will dig into the sides and still be easy enough to turn with a screwdriver by hand.

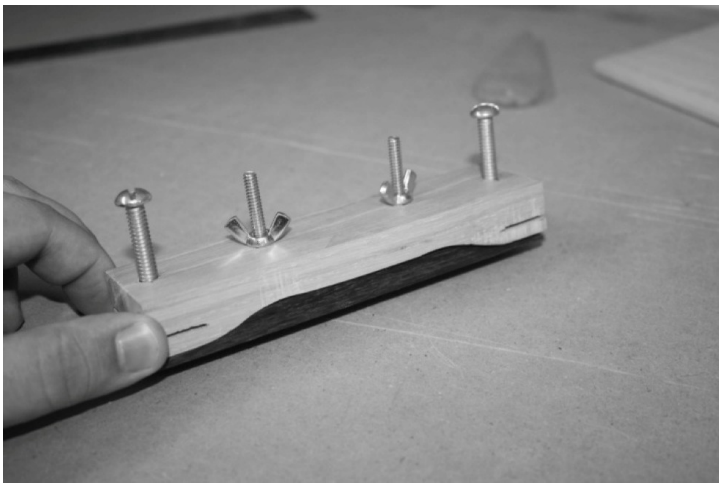


When the holes have been drilled, they will look like the picture above, close to the edges but not too close, and right in the middle of the piece. If the bridge being drilled for has very thin wings, the holes may need to be moved closer to the front or back to be able to effectively press down on them. Typically, guitar bridge wings are not this small, and leaving the hole in the center will work just fine.



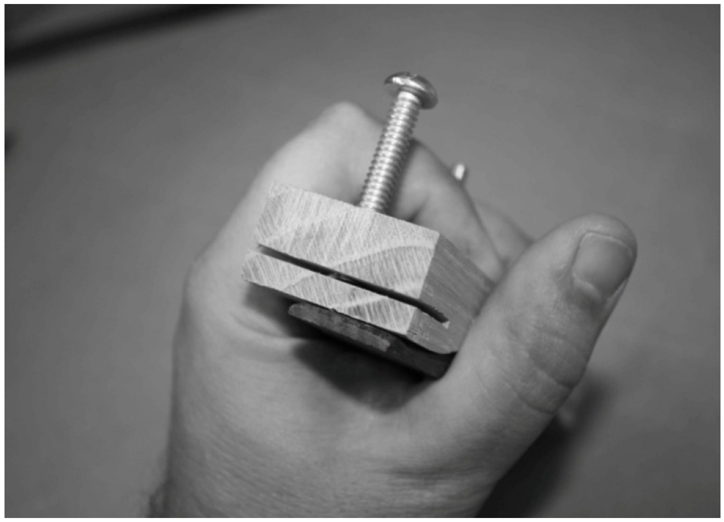
To begin assembling the caul, start with the 1/4-20 machine screws on the outside holes that were just drilled in the last few steps. Turn them in with a screwdriver so they are deep enough where the tips are visible through the cuts on the ends. Do not screw them far enough that the tips touch the bottom piece of wood, only turn them until they are visible.

The screws should be tight fitting, yet easy enough to screw in with a hand screwdriver. The first time they are threaded in, it should take a little longer, but once a thread pattern is cut on the insides of the holes, subsequent uses will be far easier to turn. Make sure they go in straight the first time, and they will always go in straight from then on.

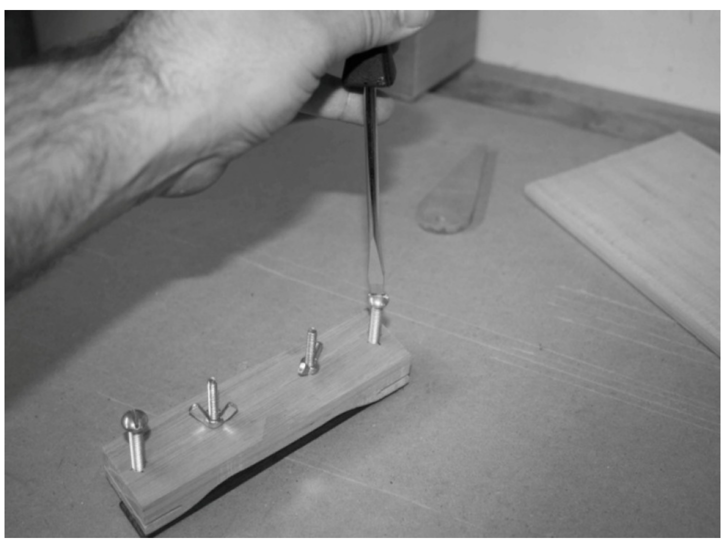


Place the caul on top of the bridge and insert the screws through the bottom. Thread on the wing nuts and apply a little pressure to snug them against the caul. The screws are passed through the bottom first in this example because the bridge is not being glued to the guitar body.

In practice, the screws are ran through the top, and the wing nuts are threaded on inside the guitar body. It is easy to reach the bridge area through the soundhole and hold on to the wing nut while a screwdriver tightens the screws from the top, applying the needed clamping pressure.

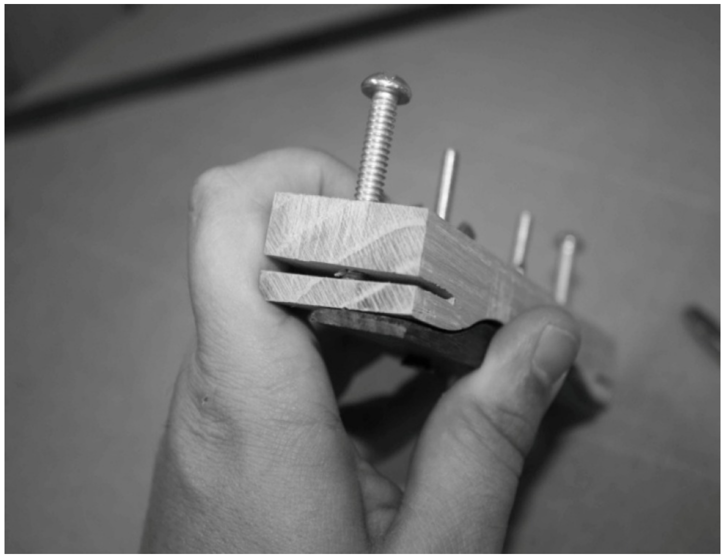


At this point, the ends of the clamps should look like the above picture, with the screw clamps not activated, and the bridge wings not under any pressure. This will change once the screws are tightened, and the bottom flap of wood is pressed against the wings. When the unit is on the guitar, this is a simple matter of turning the screw a couple turns, and feeling the caul make contact with the bridge wing, locking it in place.



Use a screwdriver to activate the clamps after the bridge has been locked in place with the center two screws. Only a couple turns are needed to actuate the clamps on the ends, sometimes less. Watch for a little

glue squeeze out and feel the screw become harder to turn to know when the tension is correct.

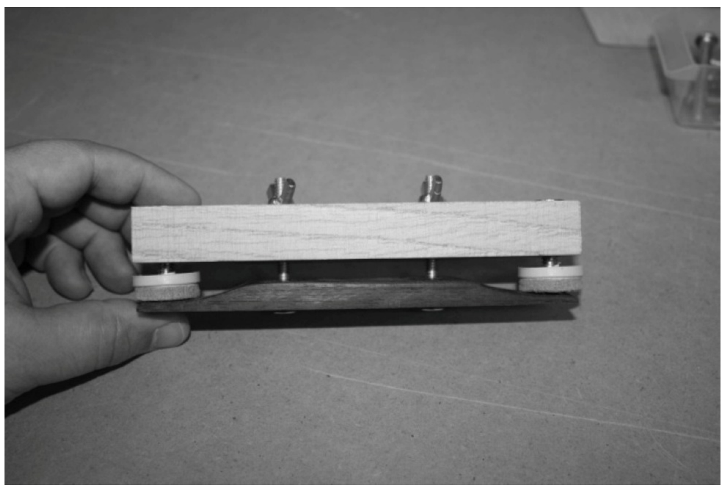


With the caul off of the guitar, the downward progress of the lower flap of wood can be seen, but will not be as easy to see when actually gluing the bridge to the guitar. This is for illustration purposes only, and shows how the clamp actually works.

Though these cauls can be used for many bridges, they do all need to be about the same size and shape to be effective. Typically, the same size bridge is made for many guitars by most guitar makers, so perhaps only a couple of these will be needed. One for the main style of bridge, and another for each other style that is different enough from the main style to require it. This is a fifteen minute to a half hour project at most, which means that there is no reason not to make a couple of them. Leave the clamp in place until the glue dries overnight, then remove it by reversing the installation sequence.

BRIDGE CLAMPING CAUL NUMBER TWO

This version of the bridge clamping caul is for luthiers who use the same size blank for their bridges but they are not all necessarily the same exact size and shape. It will work for many bridges that are approximately the same, and will hold the center as well as the wings in place while gluing.



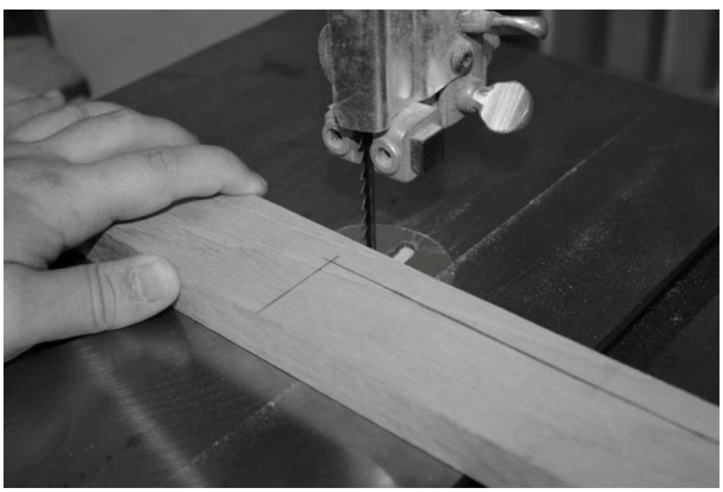
This caul is designed to hold the center of the bridge tightly against the soundboard, as well as hold the wings of the bridge in place. The caul itself is a piece of scrap wood with holes drilled in specific locations, in order to accept the screws and threaded feet.

The construction of the bridge clamping caul will require a few items from the hardware store, none of which are very expensive. First, a pair of screws that are 10-24 size, with the matching wing nuts will be needed. These are thin enough to pass through the 3/16" holes in the bridge for the pins. Next, a pack of chair leg feet with threaded posts is needed, as well as a pack of matching threaded inserts.

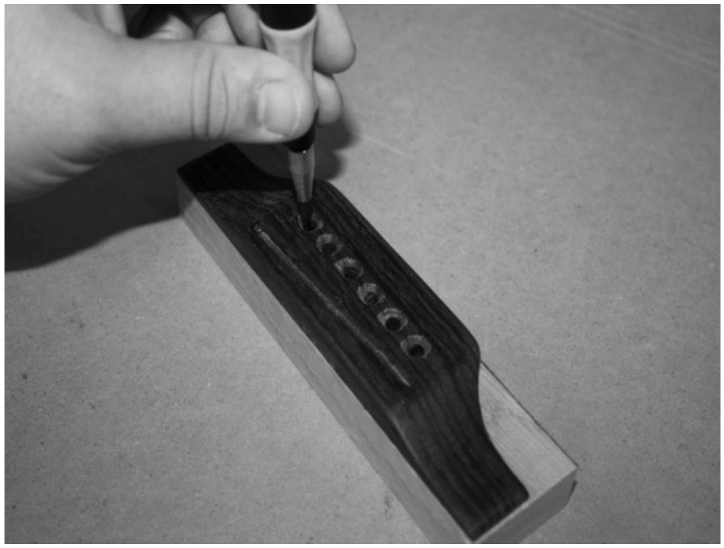
The threaded inserts will be attached to the caul and provide a set of metal threads for the chair leg adjusters. The reason the chair leg adjusters need to have threaded posts in the middle is so they can be adjusted by turning them, holding the bridge wings in place. Make sure that the inserts mach the thread pattern on the feet, and test this in the store before walking out.

Also, a piece of scrap wood, preferably a strong species like Oak or Maple will be needed in order to make the caul itself. This can be any 4/4 thickness piece that is large enough to make a caul roughly the same size as the average bridge.

Use an existing bridge as a guide for making a caul which will fit over it. Lay the bridge over the piece of wood, and mark a line around it. If no bridge is available, make the caul the same size as a bridge blank, which will ensure that it is usable on any number of bridges that can be made from that size blank. Reinforce the lines to make them dark, then head over to the saw to cut the piece out.



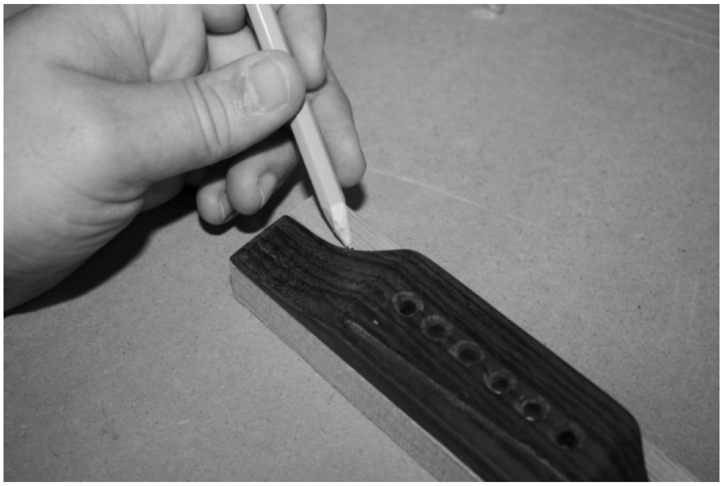
On the band saw or the table saw, cut out the shape of the caul, following the lines as a guide. It is important to stay on the outside of the lines just barely as the cut is made, preserving the size of the piece as it was drawn. This cut can also be made with a hand saw, being mindful about keeping the blade straight and making clean cuts.



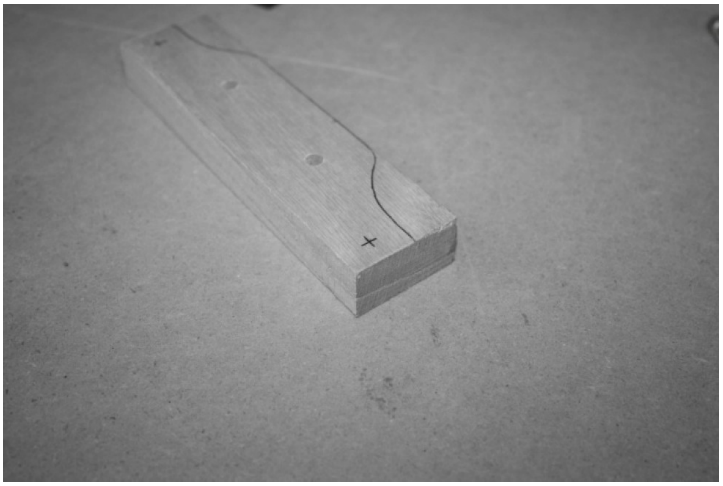
Use a metal scribe or awl to mark the centers of the bridge pin holes for the high and low E strings, which will be where the holes will be drilled for the attachment screws. If a bridge is not available, measure out the distance of the string spread, or use the bridge pin drilling guide discussed earlier in this chapter to line up the holes.

If using the bridge pin drilling guide to drill the holes as well as line them up on this caul, there will never be a fear of the clamping caul working on a particular bridge or not. The holes will always line up, because they were made from the same template.

The marks will need to be drilled through with a 1/4" drill bit in order to provide clearance for the screws, as well as a hole size that is similar to the bridge pin holes. Use a drill press or hand drill to make these holes, carefully following the marks. After the holes have been drilled, hold a bridge over them if available and check that they line up well. Measure them once more with a caliper or other measuring device, and check that the spread is the same as what was plotted earlier.



Draw a rough bridge shape onto the caul using a bridge as a guide or by following the measurements of a bridge that will be made.



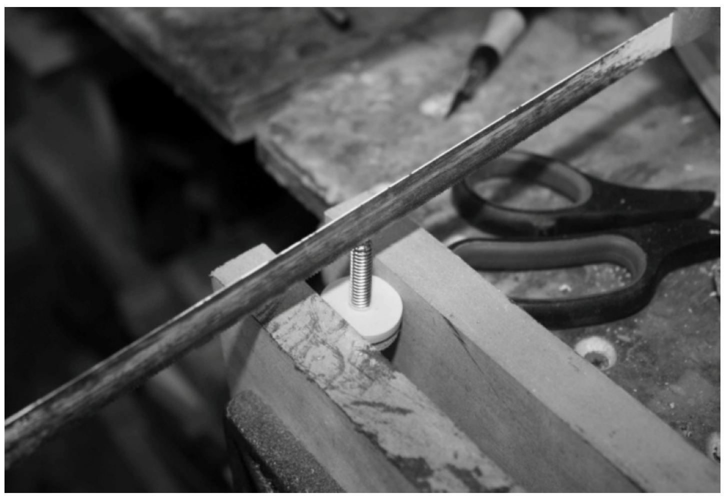
Measure 1/2" from the edges and make a mark in the center of each wing, for the placement of the threaded feet that will hold the bridge

wings.

To determine the drill size that will be needed for the threaded inserts, a caliper is very useful. This tool can be used to grab the insert between the threads and get a specific measurement. This caliper can then be used to test fit a few drill bits to see if they fit in the same gap, eventually leading to the correct bit size being chosen. A bit that will clear out room for the solid center portion of the grommets will be needed, and will vary depending on what grommets are purchased and from where. If no caliper is available, sight the bit by eye and drill a test hole in a piece of scrap of the same species. Try fitting the insert, which can always be removed once the test is complete.

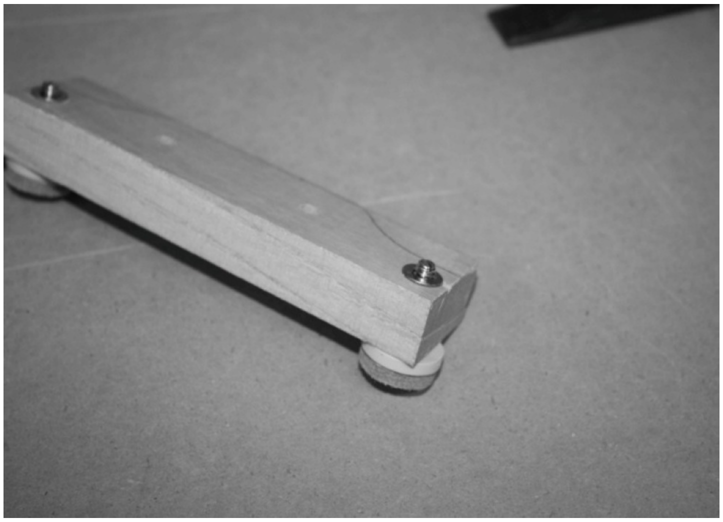
With the correct bit size selected, drill out the two locations following the marks made earlier over each edge. Drill the holes as straight as possible, which will allow the feet to work better as well. A drill press is the best place for drilling these holes, however it can be done with a hand drill carefully.

Place the threaded metal inserts into the holes, and crank them in with an allen key, or by using a bolt and a jam nut. The package will specify how the particular inserts need to be turned in, and the directions on the package should be followed.

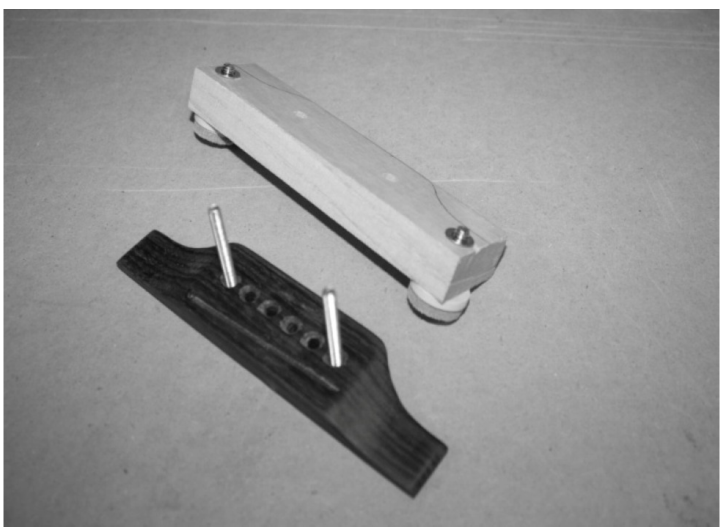


In order for the feet to be able to work in the same fashion as a clamp, a method of tightening them against the bridge wings will be needed. In this case, a simple way of adding a slot to the top of the bolts will make it so a screw driver can be used to turn them in and out. This is most easily done by using a hack saw and making a slotted cut right through the top of the post, which a thin screwdriver can turn.

Hold the foot in a vise or insert it from the bottom of a hole drilled in the workbench. This way the post and foot is held in place while the saw makes the cut. Only cut through the top of the post about 1/8", which is plenty for the screwdriver to take hold.

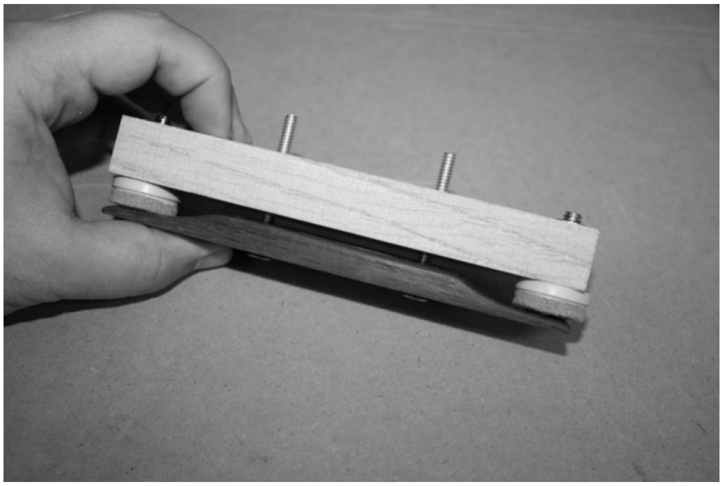


Screw the feet into the inserts once the slots have been cut in both, in order to test that they fit well and are also lined up straight. If they are a little off, it is not a huge deal. However, a serious angle will need to be fixed. Depending on how bad the feet go through the caul, it may have to be re-made.

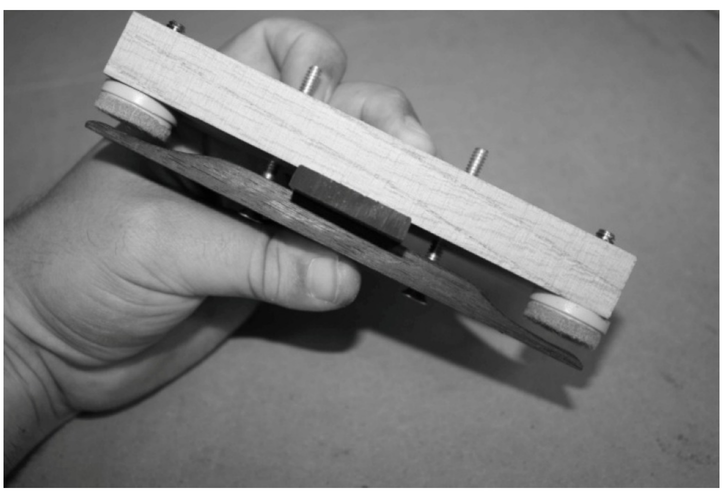


Insert the screws through the bottom of the bridge and send them through the caul as well. Tighten down the wing nuts and check that the entire until fits well together, and there are not any construction issues that need to be addressed.

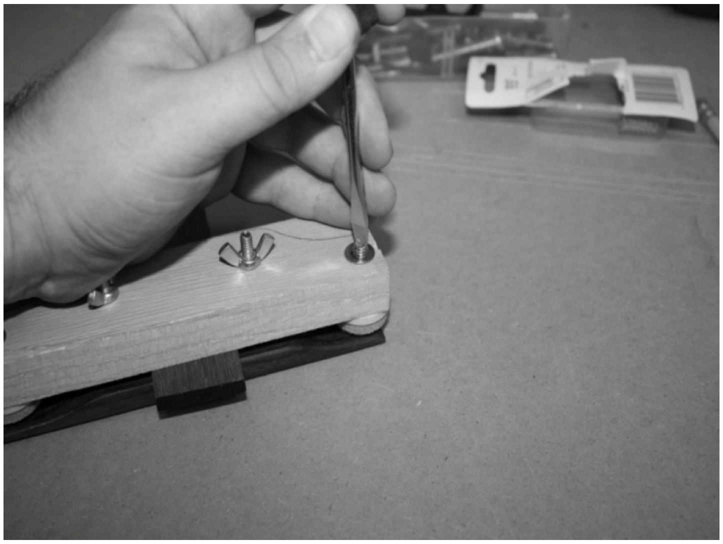
Assuming the piece fits well, and the feet screw in and out easily, it is time to see how it will be used on a guitar when it comes time to clamp down a bridge while the glue dries.



Depending on how tall the center of the bridge is versus the wings, a small gap may exist between the caul and the bridge.

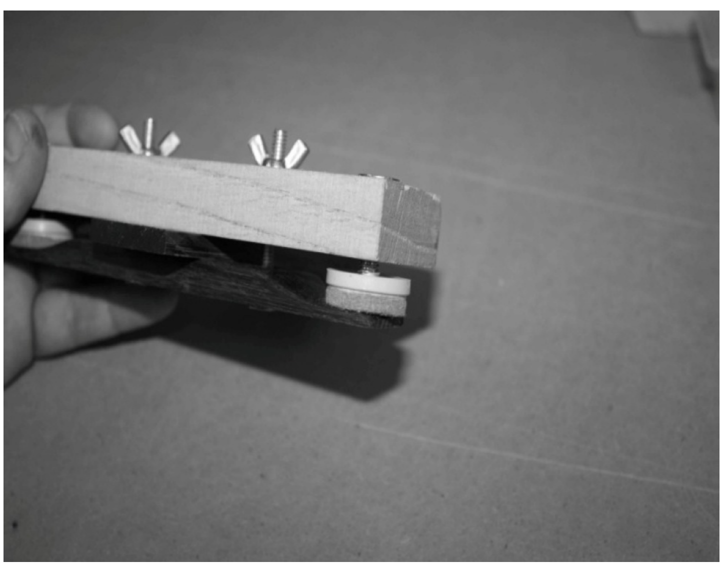


A scrap piece of soft wood like spruce or pine needs to be inserted in between the caul and the bridge to fill the gap, and give the clamp something to press against.



Once the wing nuts have been attached and tightened down, pressure will be created between the bridge and the soundboard. The wings of the bridge will still need to be pressed down, and this is where the threaded feet come into play. A small screwdriver can be used to turn the feet so they press against the bridge wings, holding them firmly against the soundboard.

The center of the bridge will be held tightly by the bolts and wing nuts, and will not separate no matter how much pressure is made by the small feet, which is why this works. The feet hold the wings down, and the bolts hold the center of the bridge in place as well.



It is a good idea to set the caul in place on the guitar, tighten everything, and be ready to wipe up the glue immediately. Wiping up as much glue as possible makes the process much easier than waiting for it to be hard as a rock and then trying to clear it all out. A chisel will be needed if the glue is dry, and this can cause all kinds of accidental dings and cuts to the soundboard.

Also, be sure to keep the felt covered feet from getting covered in glue, which will dry and harden inside the felt. If this happens, the feet can scratch the bridge wings, causing damage that will need to be repaired after the bridge has been clamped to the guitar.

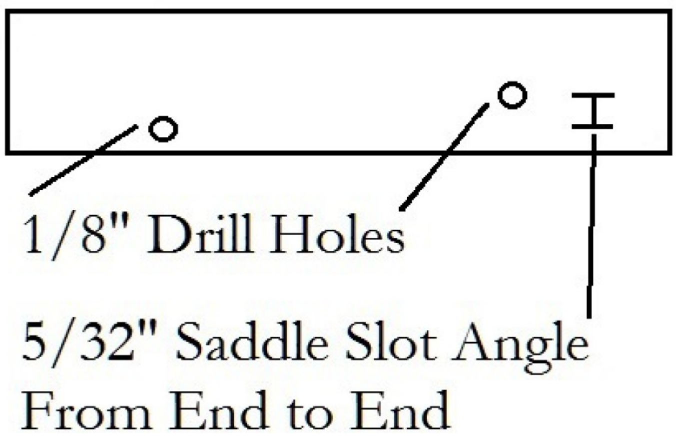
These small bridge clamping cauls are so inexpensive to make, and so easy that they can be made to fit several different styles of bridges, assuming there is a need in the shop. A couple of these can be used to glue several guitar bridges at once, and for a very low cost per piece.

Using a clamping caul is a very efficient and effective way to ensure that the bridge has been tightly adhered to the soundboard. There is somewhere between 150 lbs. and 200 lbs. of string tension on an acoustic guitar. Knowing that the bridge is glued down accurately and tightly is a very relieving bit of knowledge to have.

SADDLE SLOTTING JIG

Making the slot in the bridge is one of the more difficult aspects of bridge making, but a simple jig can make it much easier. Many times books will say to make this slot with a thin chisel by hand, but if a router or a Dremel tool are available, it is much easier and more accurate to do it by machine.

The jig itself is very easy to construct, and can be made from pieces of scrap wood that are laying around the shop. It is essentially a wooden base, with an angled rail that the router rides against. The angle of this rail is perfectly set to match the saddle slot angle, so it makes an accurate slot every time. There is also a removable piece that is held to the base with a wood screw, which locks the bridge blank in place while being slotted.

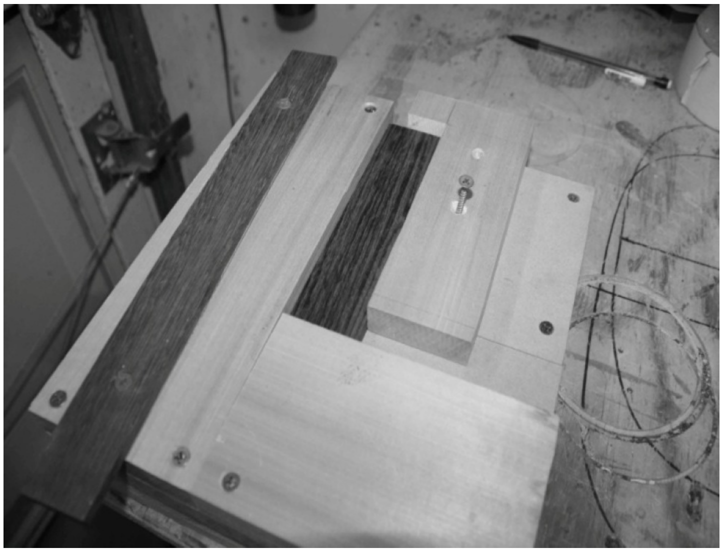


This jig will need to be made to suit the specific tools that are in the shop, and giving the measurements for the tool in the pictures will only work if the same exact tool and base are used. It is not much of a challenge to set up the jig for any router or any rotary tool. The only thing required is a bridge blank that can be used as a method of calibrating the jig.

Plot out the location for the saddle on a bridge blank, and mark it clearly on the surface. At the very ends, drill two holes that are the same diameter as the saddle that will be installed. These are usually 1/8" or less.

This can be seen in the diagram in the lower left hand column. Typically, the saddle is anywhere from 2-1/2" to 3" long, and is angled around 5/32" to 3/16" from end to end. This means that the drill location which is closer to where the bridge pins would be, is 5/32" to 3/16" further behind the drill hole closest to the front edge. When these two holes are connected with a slot, it will be angled slightly back, providing the needed compensation for the strings.

Once the bridge has the ends of the saddle slot drilled out, it can be used to set up the angled fence on the jig. This will determine where the cutter goes, and the angle at which it will cut the slot. The base of the jig will be around 12" by 12", though it may be larger if a full sized router is being used to make the slots. This jig is used with a Dremel and a router base, so it is perfect size.



Build the jig so that the router has a nice and wide path to cut through, and leave a little room on the left hand side for installing the rail. In the above picture, the rail is already installed, but for now hold off on adding that piece.

Once the jig is built with the exception of the rail, place the calibration bridge made earlier into the center, and use the moveable piece to lock it in place with a wood screw. If the bridge blank is a little loose, try folding over a piece of 220 sandpaper so the grit is facing outwards, and stick it next to the bridge. Sometimes this little extra filler can really help to keep the bridge blank steady. The Dremel or router will have no trouble lifting a loose blank and destroying it, so be sure to lock it down tightly and use some sandpaper shims if necessary.

To position the rail, first place the same diameter bit into the router or Dremel as will be used to route the saddle slot. Then, place the tool on top of the jig, with the cutter inside the hole in the bridge. This will be the starting position of the router, and where the fence will need to be placed at this end.

Tape one end of the fence down, making sure it is touching the router at all times. Then, move the tool to the other hole, and pivot the fence rail until it is touching the base again. This is the stopping point of the cut, and this is where the other end of the rail will need to be locked down.

The important thing to do when setting the rail, is to make sure the tool being used to make the cut is touching the rail before either gluing it or screwing it into position. The Dremel in the picture above can be seen clearly against the fence, and a wood screw is used to hold the rail in position. Take some time and double check the position of the rail by moving the tool from hole to hole several times if needed. This way it can be absolutely certain when the rail is screwed in place, that it is exactly where it needs to be.

Once the rail is in place, a test route can take place, where a very shallow pass is made with the router or Dremel. Do not make a very deep pass, as only around 1/16" will be enough to check the accuracy of the piece.

Remove the bridge blank from the jig, and verify that the slot connected the two previously drilled holes directly, without any deviation from a straight line. As long as the rail was placed correctly, and was made with a straight piece of wood, the route should be good.

With this jig, routing the saddle slot is simply a matter of putting a blank into the jig, locking it in place with a screw and a piece of wood, and making several passes with the router or Dremel.

No sizes were given in this example, because depending on what tools are going to be used, the jig may be drastically different in size. As long as the router or Dremel can ride long the top of the jig and is unobstructed, then the jig will be just fine. Take the time to set the rail correctly, and it will create perfect saddle slots consistently for as long as the jig is used.

SHOP MADE BUFFING STAND

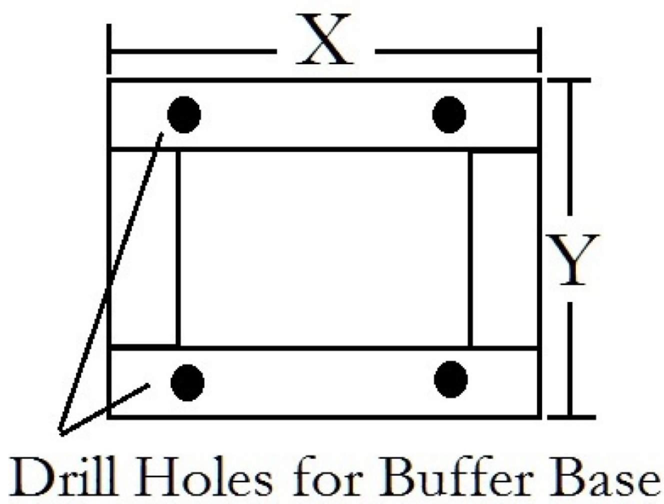
Having a buffing setup in the shop is a fantastic way to get a very high gloss finish and a truly professional look. However, a buffer and all the accessories can take up a large amount of space. A pedestal style buffing mount can help alleviate these problems by consolidating the buffing system into one area, and keeping the footprint small.

The buffing station in the picture above is very easy to build from pieces left around the shop, and places the buffer and all the accessories within easy reach. There is plenty of room on the side away from the wheel for storing additional buffs as well as placing baskets to store compound. The buffer itself sits on top of the pedestal, where buffing a guitar or a bridge are very easy and comfortable work.

The entire structure can be made from plywood or MDF, and some wood screws to hold it all together. The base is made from 2x4 pieces that are screwed to the pedestal shaft, and all the wiring and power are ran internally. A simple on/off switch controls the buffing machine, and it is light enough to be moved around the shop when needed.

Before any construction can begin, the buffing motor needs to be measured. The length and the width of the motor base are going to determine the length and the width of the pedestal that has to be made to support it.

Measure the bolt pattern on the bracket on the bottom of the buffing motor, and record these measurements someplace. In this case, this is a swamp cooler replacement motor from a hardware store, which just so happens to spin around 1700 rpm, which is fantastic for buffing.



The motor can be attached in one of two ways, the first is illustrated in the diagram above. This is a top view of the pedestal, showing where the drill holes would have to be in order to screw it directly to the top. This is one method of attaching the motor, and it does require that the width and length of the pedestal be made exactly the correct size.

The width and length of the pedestal will be determined by the buffer motor base, and the bolt pattern that is already on it. However, if this seems like too much work, a top plate can be used on the end of the pedestal, which would eliminate the need for such accurate measurements.

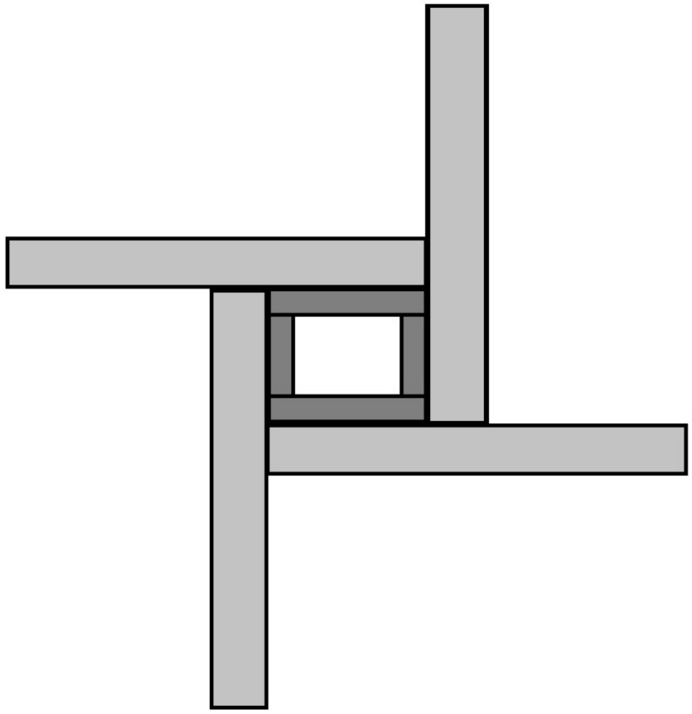
The picture above shows a piece of MDF that has been screwed to the top of the pedestal, in order to create a larger space for attaching the

motor. This is significantly easier than making the pedestal the exact same size as the bolt pattern, and makes the pedestal reusable if the motor should need to be replaced.

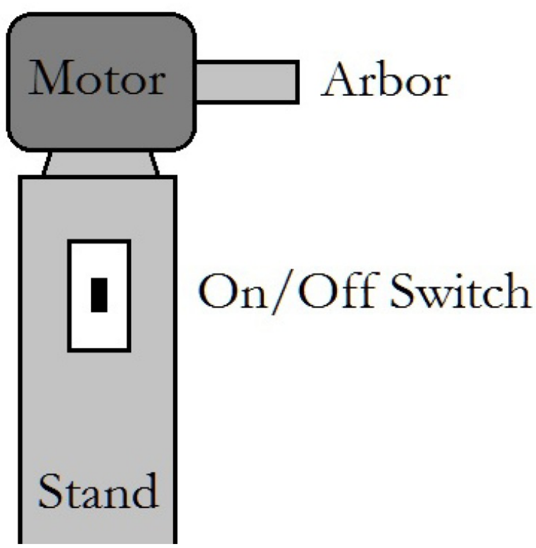
The pedestal shaft will still need to be about the same size as the motor base, simply to be able to hold it all up nicely, and in this case the pedestal size is 4" wide by 6" long. If the motor is significantly larger, it would be a good idea to make the base 5" x 7" for a little extra mass. The motor in the pictures is a 3/4 hp swamp cooler motor, which weighs in the neighborhood of 40 lbs.

The base is made from a few pieces of 2x4 or 2x3, that are screwed to the bottom of the pedestal, and stick out on all four sides. They need to be wide enough that they keep the unit standing upright safely, but not so long that they get in the way of the user while they are buffing.

This pattern of attachment was chosen because it does not involve cutting or shortening any of the legs, and keeps the pieces of wood solid, which does not reduce their strength. Each leg is 12" long in the picture above, and they could go up to 15" and still be comfortable. The unit does not wobble at all, nor does it tip very easily. The legs should be made a little wider, just in case, because the unit will be top heavy, and this will reduce the chances of it falling over.



The diagram above shows a view from the bottom of the buffing pedestal, detailing how the legs are attached. Screws are driven into the areas of the legs where they make contact with the central pedestal, and also where the ends of the legs make contact with each other. In this way each leg holds on to another part of the next leg, as well as the pedestal.

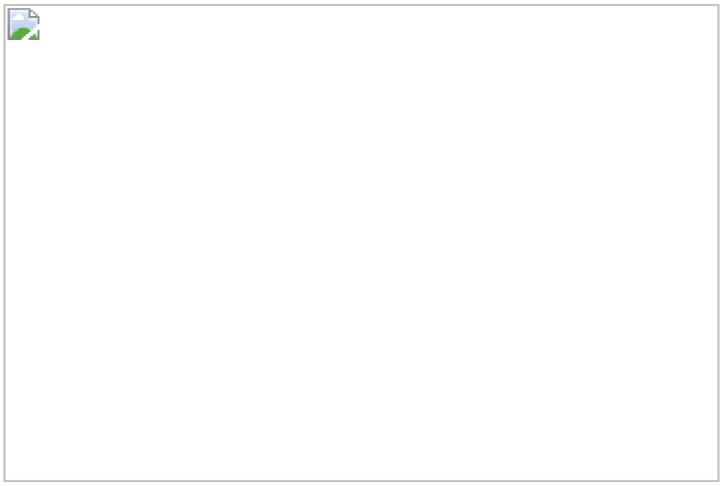


The whole unit is put together with the motor on the top, the hollow shaft in the middle holding it up, and the legs on the bottom for stability. Once the basic frame has been made, it is now time to add the electrical elements as well as the final touches.

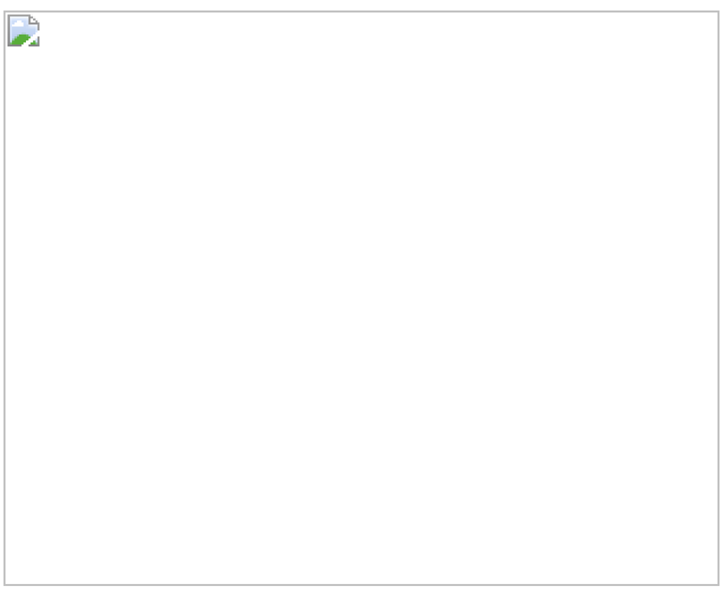
Each buffing motor or store bought motor will come with a set of instructions for how to wire a plug to the unit. These are important to follow for a few reasons, mainly because it will determine the rotation direction, as well as speed of the motor. The buffing motor should rotate towards the user at a speed around 1700 rpm or a little less. Too fast a motor will burn through a finish too quickly, and is hard to work with as a buffing motor.

Use a store bought thick gauge extension cord or appliance replacement cord, and follow the instructions for correct use. The power cord needed is a thicker gauge, appliance style cord, that can handle the rigors of heavy use. Make sure to get a cord that is several feet long, so that there is some slack to reach an outlet.

Once the motor has been wired to a long cord, it will need to have an on/off switch wired in just before the motor. Follow the instructions inside the switch package, and break the positive lead with the switch. This will allow the power to be cut directly at the machine, making it safer.



Make sure to hide the wiring and the power cord inside the pedestal, drilling a hole at the bottom to let it out. This way all the wiring is in a safe and internal location, away from fingers. Running the cord out through the bottom also gives a more professional look to the piece. A couple of angled dowels can be inserted near the exit hole and the cord can be wound around them while not in use.



Buffing wheel storage should be made on the side opposite of the spinning wheel, to ensure different grits do not end up being deposited on the spare wheels while they are hanging. If the wheels have holes in the

center, drill and place dowels into the pedestal that the wheels can slip over. Space them accordingly, so that they do not touch each other.

If the wheels have bolts in their centers, like the Beall system, drill holes into the side of the pedestal that these bolts fit snugly into. This way, many buffs can be hung from the side, keeping them at close reach for when they are needed.

Baskets can be hung from the back, or small rectangular buckets can be made from scraps to hold bars of compound or wax. These do not have to be very thick, and can be simply screwed in place with a few wood screws. Again, keep all the stored items away from the spinning wheel, in order to keep different compounds from being deposited on the different wheels.

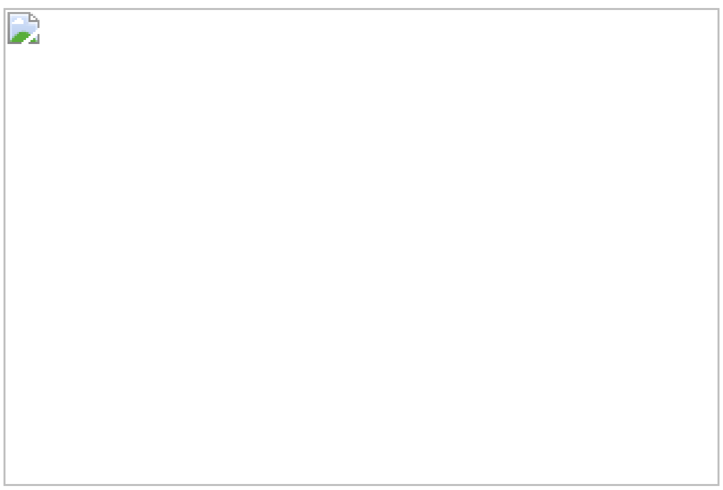
A pedestal buffer like this can make buffing in a small shop a reality for anyone who wishes for an easier way to get a mirror finish. The whole unit, as well as all the accessories and compounds only take up a few square feet of space on the floor, and it is light enough to be moved anywhere it needs to be.

While not in use, keep a cover over the machine as well as the buffs, in order to protect it from contaminants, like sawdust and metal shavings. This can be a store bought plastic cover, or it can be as simple as an old bed sheet. Keeping the buffs clean, and keeping the motor dust free will extend its life, and ensure it provides many long hours of service.

PEG HEAD DRILLING GUIDE

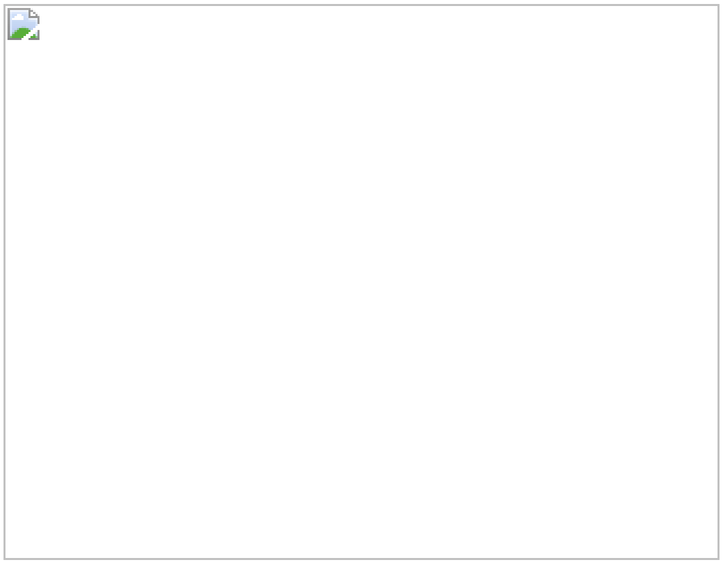
Drilling the holes in the peg head for the tuning machines can be hard to do without some sort of a guide in place. Measuring the locations carefully and drilling with a good drill bit and a drill press will make accurate holes, but it is even more accurate to have a template to drill through.

A peg head drilling guide is just a piece of wood with a small fence glued to it, that can be clamped to the guitar headstock. While clamped, it is drilled through and the holes are accurately placed.

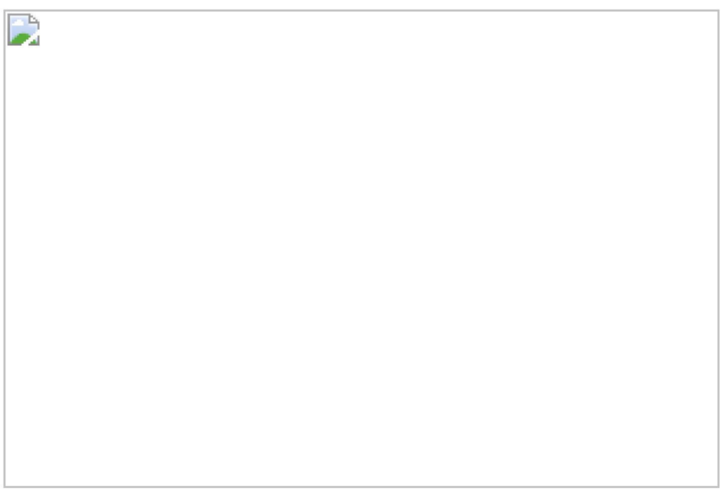


This guide will work best with headstocks that have flat sides or close to flat sides, though it can be adapted to fit any shape as needed. It is a piece of flat wood that is 2" x 5" and 1/4" thick, with the holes for the tuning machines carefully drilled into it.

Select a piece of hard wood, and depending on the locations for the tuners being used, drill three accurate holes about 3/4" from one edge. The fence that will be glued underneath, will determine the final distance that the holes are from the edge of the headstock, so it does not matter at this point.



On the bottom of the guide, the fence is glued in place, so the gap left behind is the same distance as how far into the peg head the tuners must be drilled. If the tuning machines need to be 1/2" into the peg head, then glue in the fence so there is half an inch between the center of the holes and the inside edge of the fence. The fence is made from a piece of wood that measures 1/4" x 1/4" x 4". The inside edge of the strip needs to be straight, as it determines where the peg head holes are drilled.



This view shows the fence in place along one edge of the guide, and the next picture will make everything up to this point very clear.

The guide is placed on the peg head with the fence on the bottom, and is held tightly in place with a clamp. A drill is then used to create the holes, drilling through the template. After one side is done, flip the template to the other side and drill the holes the same way. It helps to draw a horizontal line through where the top two holes need to be on the peg face. This way the guide can easily be lined up in the correct position when flipped to the other side. Different guides can be made for different peg head shapes by modifying the fence shape, and they will all make drilling the tuning machine locations much easier.

FLAT WORK BOARD

Having a flat, clean surface to work on for certain parts of guitar making is very helpful. Work benches tend to be a magnet for dried glue, chisel gouges, spilled finish, and many other less than desirable things. Getting these on a soft guitar top will easily ruin it, so having a dedicated space is nice.

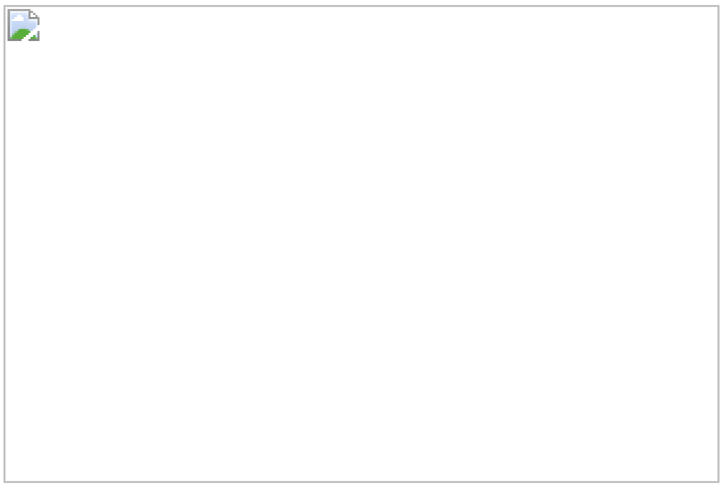
The problem with a dedicated space is that most people do not have the room for it. Most guitar makers in the beginning tend to work out of their garages or a single room in the house. Having a separate work bench would be almost impossible in this small of a space. Also, the inevitable issue with a fixed surface is that it starts to get as dirty as the main bench after a while.

A portable, clean, and flat surface can be had by purchasing a piece of 24" x 24" MDF that is 3/4" thick from a home improvement store. These typically come already cut in this shape, and they are very flat.

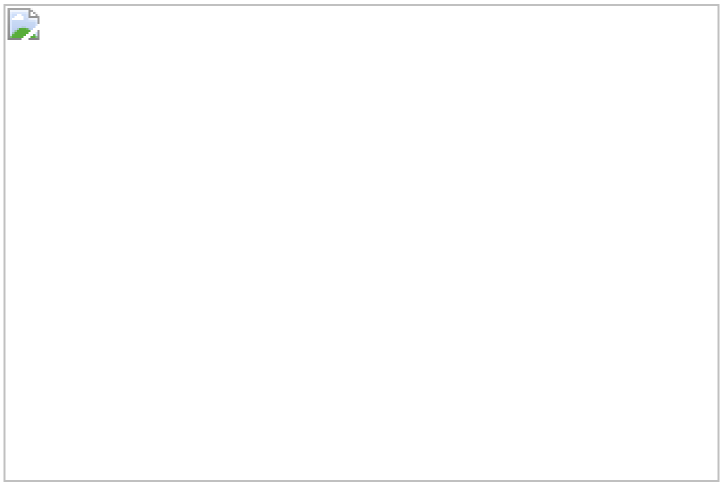
The reason MDF is suggested instead of plywood is the fact that plywood still has some areas where it can be rough on the spruce, especially if it is not very good quality plywood. MDF on the other hand, is sturdy enough and smooth enough not to cause any problems for the softer tops.

The only work that needs to be done to the board is to lightly sand the surface to be used face up with 220 grit sandpaper, and round off the corners a little as well. This knocks down any fibers that may be standing up as well as breaks the rough edges.

Wipe the surface with a cloth that is just barely damp with water. This will collect all the dust, and leave a flat and clean surface behind.



The flat work board can be stored away while not in use and pulled out easily to accomplish many tasks in guitar making. The above picture shows a back being glued together, and the flat board being used as a gluing press. When the back is clamped down, any small hard piece of debris on the bench will dent the thin wood, which is why this is done on the flat board. The board is clean and debris free all the time.



All soundboard carving should be done on the flat and clean board for one really important reason. There is a lot of force being used to carve the braces which is directly passed through the wood on to the top. Anything between the top and the bench will scratch, scar, and ding the soft wood surface. This will add time to the sanding required to repair the top, assuming there is no damage that cannot be repaired.

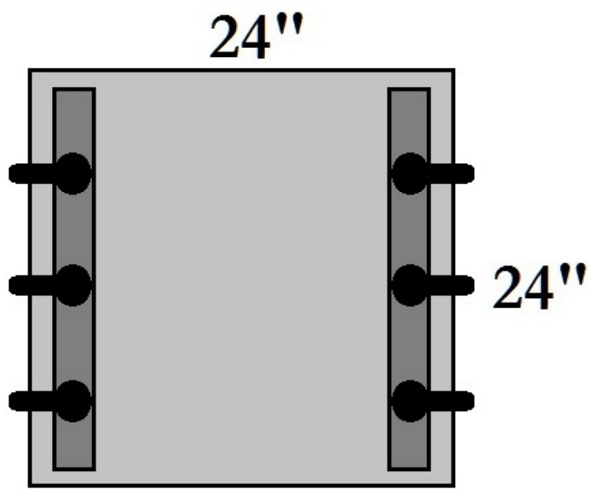
If a truly flat top is being created, the braces can be glued in place while the top plate lies against the flat work board. Since the gluing will all have been done on something known to be flat, the resulting plate will also be flat when completed.

After the work is done, wipe the board with a barely damp cloth again to catch all the sawdust and sandpaper grit, and store it away until it is needed in the future.

BOOK MATCHING CLAMP PRESS

A great use for the flat work board made earlier is to use it when book matching the tops and the backs. A good flat surface is needed for this operation, and the work board is perfect.

There are many different setups for gluing the center of the top and back together, however this one is very simple and just as effective. It also does not require buying anything since all the components should be in the shop already.

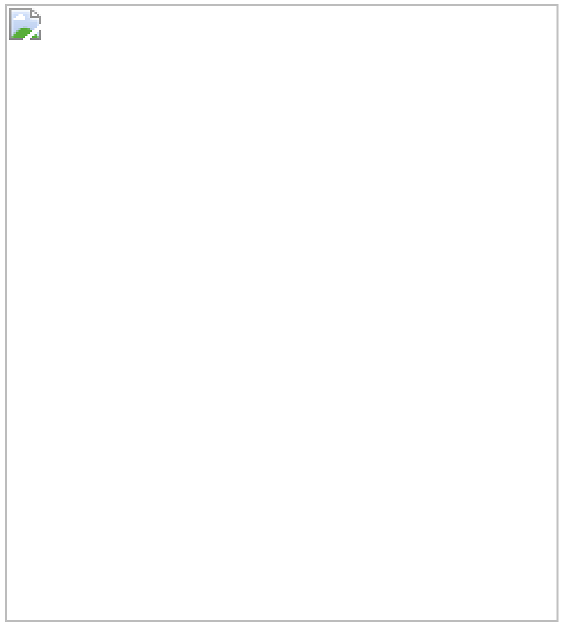


The way this method of book matching works, is by creating a space on the work board with pieces of wood clamped on each side. This space is just a little bit smaller than the width of the boards being glued, which causes pressure at the joint when the two pieces are forced flat.

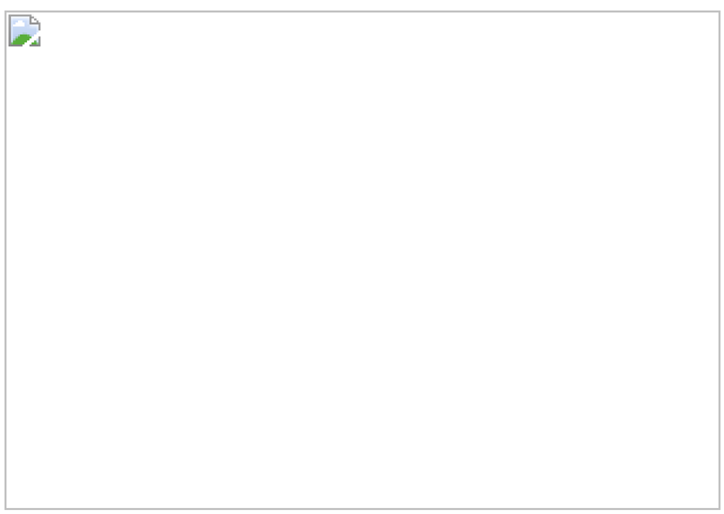
One side is clamped into place, and the top or back is used to measure where the other board will need to be clamped. A small piece of material 1/4" tall placed in the middle of the press, keeps the top or back from going completely flat against the board, making the resulting space slightly smaller. With the board to be book matched in place, the other clamping caul is placed against the edge, and clamped in place.

This diagram above shows a side view of the clamping press, with a top ready to be clamped. The boards on the ends restrict how wide the clamping area is, keeping the boards popped up a little bit in the middle. The small piece under the joint in the center holds the pieces slightly above surface while the side pieces are placed and clamped. When this is removed, the boards can be forced down against the work board and there will be strong pressure on the center joint, holding it while the glue dries.

The above drawing shows how the two halves of the top or back would look once they have the glue applied at the joint, and the center was forced down against the work board. The small piece under the center joint is removed prior to gluing the joint and forcing it down flat, and a piece of wood is placed over the center line to spread out the clamping pressure.



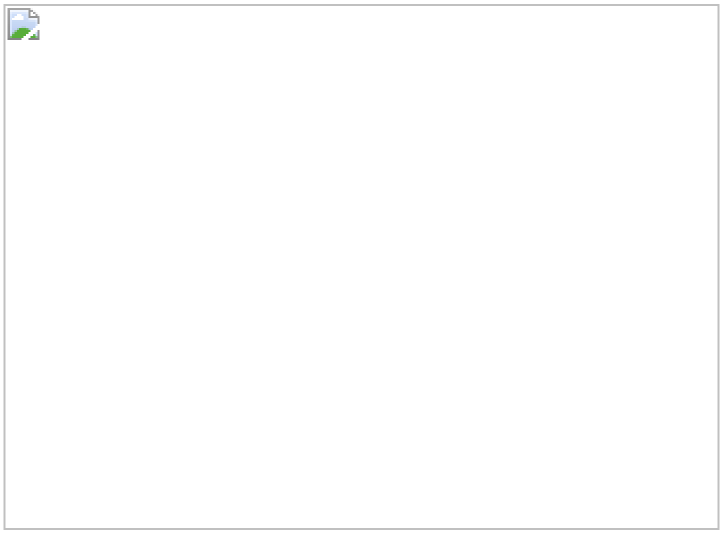
The clamp, once fully set up will look like the above diagram. The center is clamped down with a long piece of 4/4 wood to make sure the joint is flat against the work board while the glue dries. It is helpful to put a long piece of wax paper under the joint and on top of it to catch the glue being squeezed out. If the wax paper is not used, everything will be glued to the work board when it dries.



The above picture shows a guitar top ready to be glued at the center joint. The mating edges have already been planed so they meet

perfectly, and that no light shines through the joint when held together.

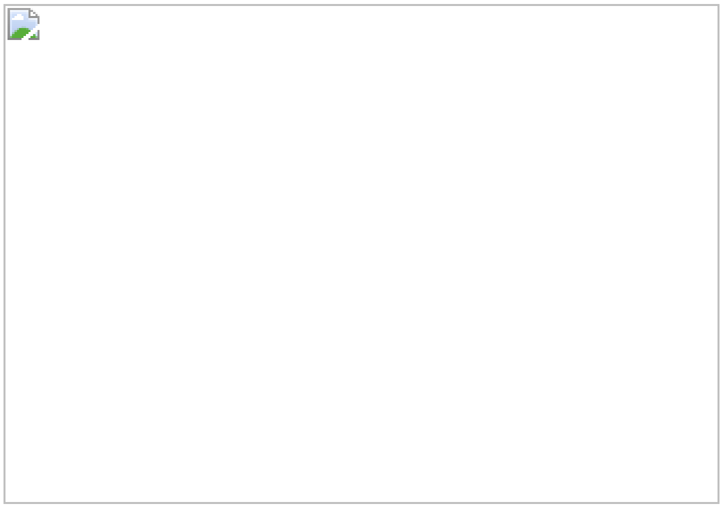
The clamping caul on the right is clamped into place first, almost at the very edge of the work board. The top itself is then used to measure the correct distance away that the other caul needs to be clamped.



A small piece of thin wood is placed under the center of the joint to raise the middle portion up about 1/4" to 1/2" off of the work board. The two pieces of the top are then laid in position, touching each other at the center joint.

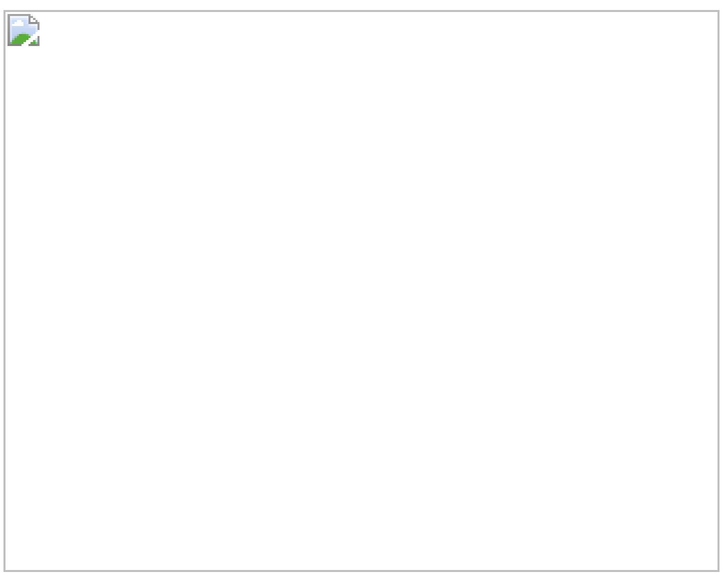
With the board in place and the center raised slightly, the clamping caul at the left is placed against the edge of the top. At that position it is clamped down tightly.

Since the center joint is raised up slightly, the space created by the two clamping cauls is smaller than the width of the two boards. When the small piece at the center is removed and the center seam is pressed downwards, there will be pressure from the cauls, forcing the joint together tightly.



The glue is applied to the edges of the center joint, and the small piece under the joint is removed so the two pieces can be forced flat. A piece of wax paper is placed under the joint, and on top of it, to protect the top from being glued to the press.

With light pressure, the center joint is forced flat, and a long board is clamped over the top of the seam to distribute the pressure. A couple gym weights can be added to the center to make sure there is adequate pressure in this area as well. Also, a few stacks around the rest of the top make sure that the piece stays flat for the entire gluing process.



With the top clamped down well, leave the press overnight so the glue has enough time to cure fully. Depending on the type of clamps being used to hold the cauls in place, the whole unit can be moved to another place in the shop while it cures.

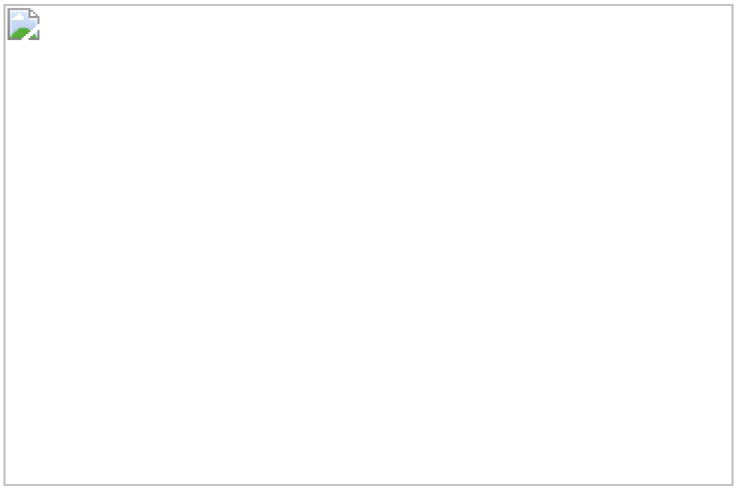
Remove the top from the press by first removing the cauls on the outside edges. This will relieve the pressure being exerted on the joint, making it safe to remove the piece. If the center clamp is removed first, the piece may bow back quickly, cracking the wood, and ruining the top.

CARPETED WORK BOARD

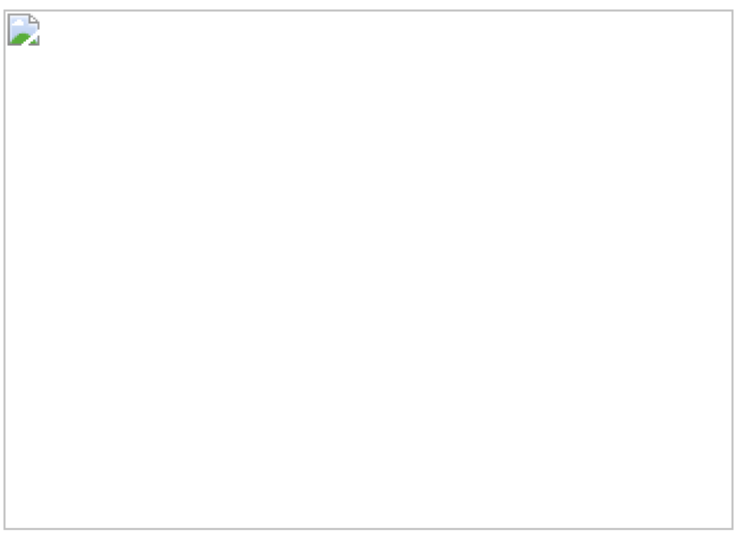
When doing the final setup on a guitar, it is helpful to have a dedicated area in the shop where the workbench is free of finish damaging particles and sharp bits of sawdust. Even the wood on most benches is too hard of a surface to set most guitars on while working on the final setup. Since the luxury of a dedicated area for stringing is something that most luthiers do not have, a solution is needed that is both portable, and safe for delicate guitar finishes.

A carpeted work board is a portable and inexpensive way to protect the finish on the guitar, and still conserve valuable shop space. The board is made from a piece of scrap, cut to dimensions, then carpeted with a low nap inexpensive piece of carpeting from a home improvement store. It stores safely away from all the debris that floats around the shop, and only comes out when a nice, soft, and particle free surface is required. This piece can be teamed up with the neck support, and worry free setup can be done on an acoustic guitar, all on the same bench.

A piece of plywood or MDF that is at least 12" x 12" is needed, and preferably 4/4 size so that it has some stiffness. The carpet can be anything from scraps lying around to a piece bought for the purpose. A thick moving blanket, or a piece of an old thick blanket from the house will also work. The point is to make a soft area for the body of the guitar to sit on while things like stringing and nut slotting are taking place.



The piece of carpet can be cut to size, and glued on with wood glue or polyurethane glue. Since the carpet is not going to go through much stress being used like it will be, a ton of glue is not needed. Spread an even layer over the surface of the wood, making sure to get a good coat around the edges more than the middle. This way the edges will stay stuck to the board and not start peeling off. Place a large flat object on top of the carpet after the glue is in place, and it will hold the carpet flat until it dries.



After the glue dries, check the carpet edges and trim them with a razor blade if needed. This is not a necessary step, however it does make the board look nicer. Also, nice tools are kept better than ugly ones, so take

the time to make a nice work board and there will be a good reason to take care of it.

If a piece of blanket or another soft material that is not very glue friendly is going to be used, simply cut the piece a couple inches larger than the board on all sides, and use tacks to attach it to the board. Lay the piece of fabric on the table, and center the wood on top of it. Fold over the top edge and tack it to the bottom of the board, using short tacks so they do not poke through. Fold up the bottom flap and pull the fabric tightly before tacking, and then do the sides in the same manner. Flip the piece over and it is done.

This chapter also shows how to make a cork lined neck support for an acoustic guitar. When used with the carpeted work board, the two of them create a safe surface to do final setups on.

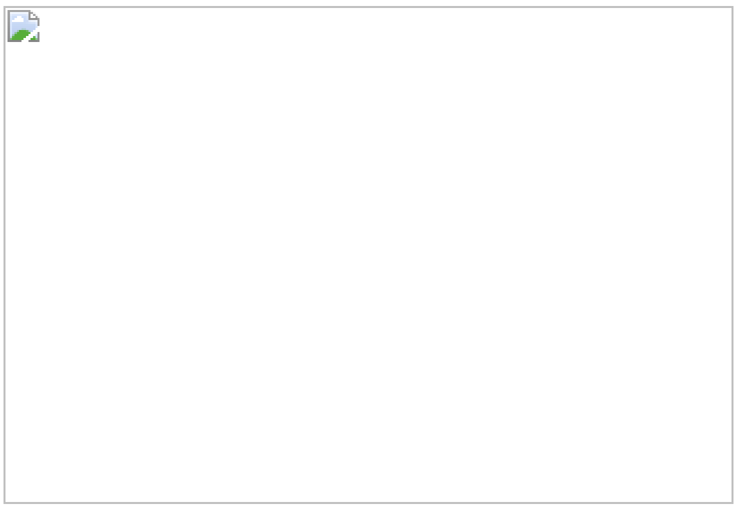
Project Notes:

The carpeted board must not be allowed to be contaminated with sawdust, splinters, shavings, or anything else that could damage the finish of the guitar being laid on it. A good method of storage is to put the whole board inside a trash bag, fold over the opening almost like wrapping a present, and tape it closed with a small piece of masking tape. This will keep the board free from particles, but still be easy to take out and use when needed.

Do not allow the board to get wet during storage, as plywood and MDF expand when wet, and can create an uneven surface to work on.

PROPANE BENDING IRON

One of several bending irons that are discussed in this chapter, the propane bending iron is the most basic and easiest to make. Most of the parts may well be lying around the shop, but if not they are very inexpensive to buy. All that is needed is a short piece of thick walled pipe, a wooden contraption to hold it while being used, and a propane blow torch.



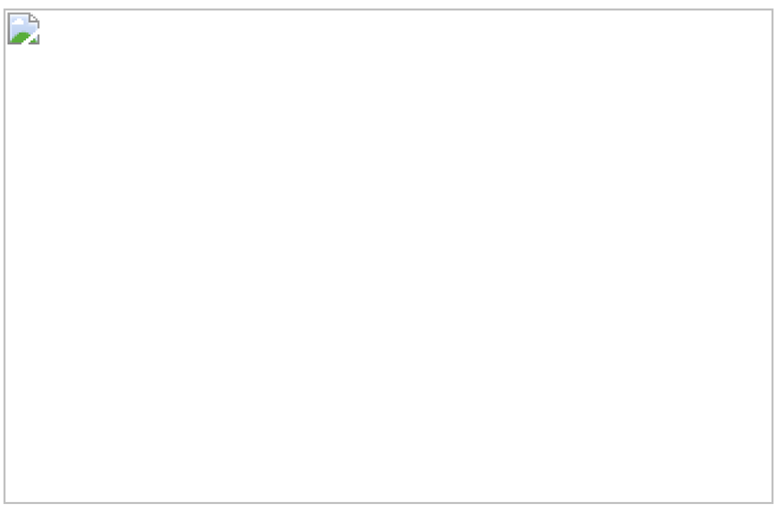
The way this bender works, is the pipe is fitted to a wooden holder and clamped to the work bench. The blow torch is then situated behind the whole unit where the fire can be directed into the open end of the pipe. The fire quickly heats the pipe up to temperature, and wood bending can take place. Due to the presence of an open flame in a shop full of wood, this type of bender needs extra attention while using. Having a fire extinguisher handy just in case something catches fire is also a good idea.

The pipe, which is the part of the bender that does the work, needs to be at least 2-1/2” in diameter, and thick walled. The small 8”-12” sections of threaded pipe at the home improvement store will work just fine, as long as they feel heavy and strong. Fence posts are another good one to look at, though a piece will have to be cut off to make a reasonable sized bender. Plus, connecting it to the wooden base is a little more involved since a flange cannot be purchased. There are thinner pipes around the

hardware store that are larger, but they are much more flimsy. These are used for air conditioning ducts usually, and they should be avoided. The issue with these kinds of pipes is that the heat doesn't spread around like on a thicker pipe. The thin walls get really hot where the flame is pointed, but not hot enough anywhere else.

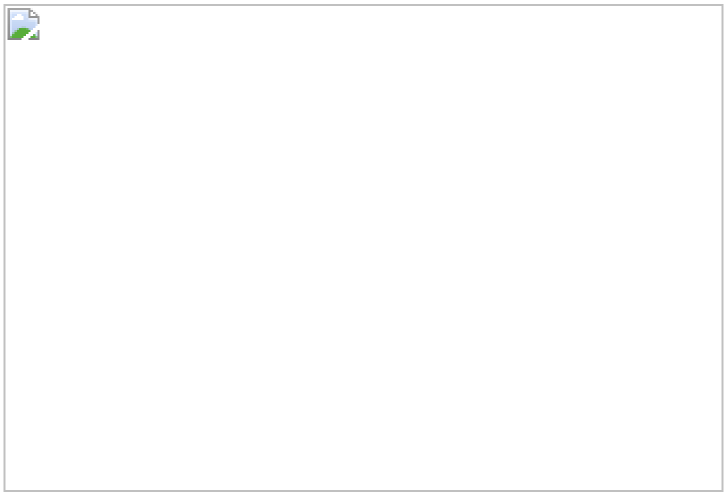
Once a pipe is selected, a cap needs to be purchased that fits on the one end, and a flange for the other end. The flange will be used to easily screw the pipe and cap to the base, and the cap will keep the hot flame from burning the user. If a propane torch is not already in the shop, an inexpensive torch head that can attach to any small propane bottle is the best. These are usually $20 or less including the first bottle of propane. Do not worry about buying any more gas at this point because the bottles last a long time.

The wood for the base can be anything around the shop, however MDF would be a good choice, because it seems to burn less than other wood. Not much will be needed, and a piece as small as 12" x 12" can be worked into a base.



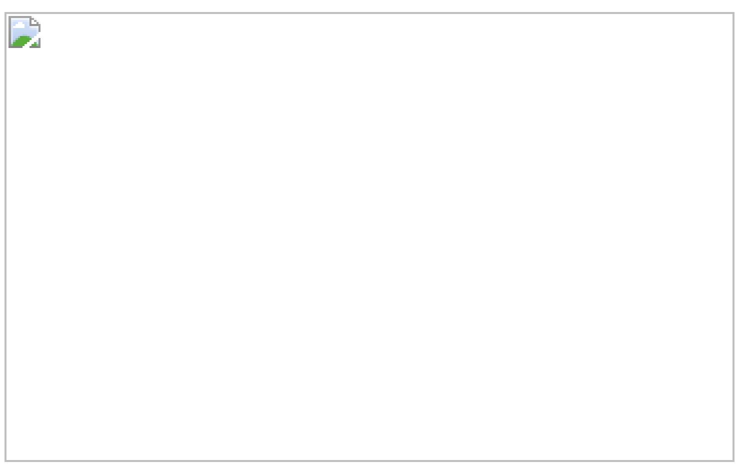
Assemble the pipe by screwing on the cap as well as the flange. Both of these should be screwed on tightly, since they will never need to be removed in the future. If there are any stickers or oils on the pipe, clean them off, because once they heat up they will burn. Also, any oil left on the pipe will ruin any piece of wood that comes in contact with it. Oil

penetrates deeply, and will show as a dark spot on the wood that sometimes cannot be removed.



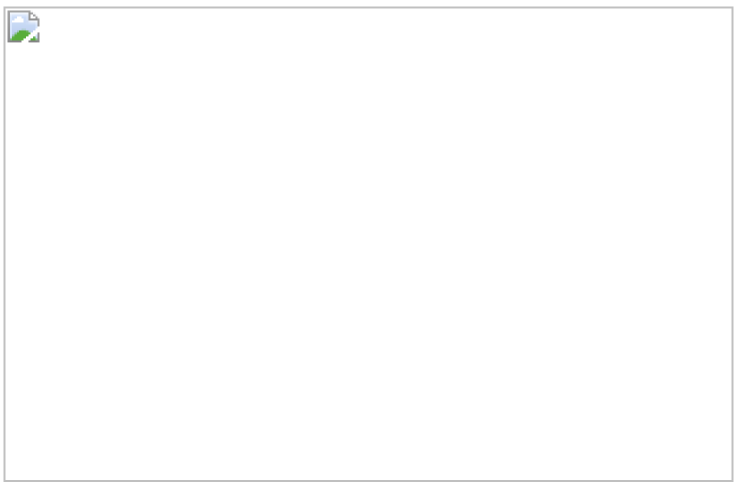
From the wood, cut the following three pieces and set them aside. A piece that is 6" x 12", and two pieces that are 6" x 6". Take one of the 6" x 6" pieces and cut it in half diagonally, making two triangles. These four pieces are all that will be used to assemble the bender base.

The 6" x 6" piece should be glued and screwed to the front of the 6" x 12" piece as seen in the picture, and the two triangle pieces used as supports. All of these pieces should be screwed and glued together because bending wood requires some force, and the base needs to be strong enough to withstand it.

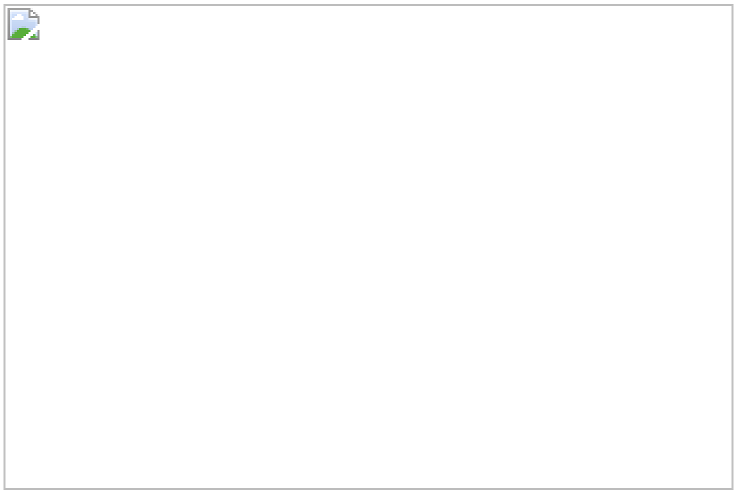


Once the base is assembled, a hole needs to be made for the flame to pass through the wood and into the pipe. Mark the center of the 6" x 6" piece, and using a compass, draw a circle around the mark that is a little wider than the opening in the pipe by about 1/4”. Do not go too far out on the hole because the pipe will need to be screwed in place, and there needs to be some wood left for the screws to grip into. Drill a center hole and use a coping saw to cut out the opening following the line, or use a drill and large Forstner bit to drill out the entire opening.

When the wood is removed from the hole on the base, the pipe can be mounted as in the picture, with bolts going through the flange and nuts securing it from the back. Wood screws are not recommended for this application, again because of the forces involved in bending wood.



To use the bender, simply clamp it to the bench near the edge, and be sure it is tightly locked down. Lay down the lit torch and point the flame into the pipe. Keep the end of the torch outside the pipe, and only let the flame go inside. Aim the flame a little lower than the center of the pipe opening, but angled enough that it hits the top of the pipe somewhere inside. After about 10 minutes, the pipe should make water drops snap and jump off the metal. Once it does that, it is the right temperature for bending wood.



The above picture shows the torch being aimed into the pipe. Notice how the end of the torch does not go inside the pipe itself, where it could heat up and possibly melt. The flame is also pointed towards the top and middle section of the pipe. This helps heat up the entire pipe because the flame is focused over a longer area, and not in one small spot.

Project Notes:

It helps to check the temperature of the iron from time to time by dripping some water on it. If the drops bounce off with a good snap, the iron is hot enough to bend with. If they sit there and sizzle, it will still need some time to heat up before working with. Getting the iron hot enough to steam water will help make sure the wood also gets hot enough to bend without breaking.

After the iron has come to temperature, it will continue to rise as the torch continues to add heat. If the bending process takes a long time, it is a good idea to turn off the gas for a little while until the iron comes back down to temperature. The way to know if the iron is too hot is that it will burn wood fairly quickly. The iron will burn the wood even at a normal temperature if kept there too long, but it will not burn much when used properly. Time and experience bending wood will help with this determination.

SIDE BENDER ALTERNATE

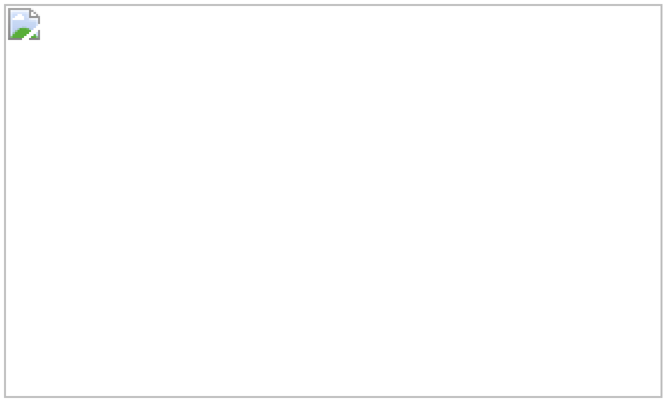
Another version of the side bending pipe can be made with an oval shaped pipe. The advantages to an oval pipe over a round pipe is that there are more radii that can be bent. The ends of the ovals get progressively smaller depending on where on the pipe the wood is bent. Also, the large broad semi-flat areas allow more of the piece to be heated at once, making for a little better performance over the long and slow bends. The lower bout in particular is much easier to form on the oval bender than the round one, because the larger space heats more of the wood, and lets the bend take shape a little more smoothly.

That being said about the oval bender, the challenge comes in finding a pipe in an oval shape that is ready to work with. There are a few places on the internet that have oval pipe for sale, and it is normally for the automotive industry. It is also pretty expensive too. The best bet might be to do what I did, and find a blacksmith.

A 12" section of thick walled large diameter pipe of about 3"-4" can be heated in a furnace and beaten into an oval by a blacksmith or horseshoe maker. They have the tools and the ability to bend a really heavy gauge piece of metal into the needed shape, and they might even let you watch. The process begins with them heating the piece in a furnace until it is bright orange and extremely hot. The piece is removed with metal tongs and struck with a hammer over and over to flatten it. It goes back into the furnace again to heat up if needed, and is struck again by the hammer. This process is repeated until the piece is a nice even oval without any dents or dings.

This is the end profile of the pipe that was bent by the blacksmith. The top is fairly flat but still with some curves, and the ends get down to a radius that is smaller than the waist on the guitar.

The bender is mounted to a piece of 8/4 wood in a kind of stockade fashion. There is a bolt through the top that secures the pipe to the wood, and the pressure of the wood holds the pipe firmly by the last couple inches.



Wood can be cut like the diagram above and the pipe bender assembled. The top piece is 8/4 size, and cut roughly as tall as it is thick. The width and height will depend on the piece of pipe being used, so there are no hard dimensions given here. Make sure to have at least half an inch of wood on the top piece, to ensure that the wood does not break while in use and send a hot pipe flying anywhere. The small screw can also be seen in the diagram, and again that is to keep the pipe from slipping out of the form. When it comes to really holding onto the pipe while bending, the wood does all the work.

The reason for the small lip on the back is so the bender can be clamped onto the edge of a workbench while being used. This can be seen in the above diagram on the right, directly below the screw location. The whole unit is clamped to the workbench with a couple bar or C style clamps, and put away when cool. Use strong clamps to hold the bender to the bench so it does not move under the heavy forces of bending wood. Also, place a metal cap in the end to help keep the heat inside the pipe, and keep clothing from catching fire.

BENDING STRAP

While bending the sides on a hot iron, sometimes the fibers on the part of the wood not in direct contact with the iron do not get hot enough, and they tear instead of bend. This can be a number of things from the bending iron not being hot enough, to the wood not having enough moisture to steam, or the back not being supported through the bend. A good way to trap more heat and steam as well as support the area being bent is to use a bending strap.

A bending strap is just a piece of flexible sheet metal that is thin enough to bend easily and return to shape. Spring steel that is very thin works the best, and is resistant to kinks. However, most of the hardware store pieces of sheet metal, if taken care of, will also make good bending straps. Look for something that is good to use outdoors or somewhere that it may get wet. Bending wood does require water, and a rusty strap will not be usable.

Once the piece has been selected, it needs to be cut to shape. The width of the sheet is determined by the maximum width of the side that will be bent on the iron. Most acoustics can be done with a 5" wide piece, though if the wood will be wider it is best to cut the piece wider. The length is mainly a personal thing, as only a few inches at a time are needed while bending on the pipe. However, there are some times where supporting a

longer run of wood is nice to be able to do, which is why this bending strap is 16" long.

After the sheet metal has been cut, it needs to have the rough edges filed off so they do not accidentally cut anyone. A fresh cut edge on a piece of sheet metal is worse than a paper cut and much sharper. Take a file and go over the edges to make them blunt, which should not take more than a few minutes. A flat metal file works really well for this, though any file will also work.

The left and right smaller edges need handles to make it easier to hold onto the bending strap while using it. Using some scrap wood, cut out four pieces that are 1" x 6" x 1/2" thick, as seen in the previous diagram. These will be used as handles on either side, so a better grip can be had on the strap.

Place one piece of wood on top of the left edge and one on the bottom. The sheet metal should come within half an inch on the top and bottom, and almost to the edge on the left. This wood sandwich will hold the ends and create grips for the piece that protect the fingers. Clamp the pieces down, and drill three pilot holes through the wood and the metal shown by the black dots in the diagram above. Screw through both pieces with short wood screws or using a tight fitting machine screw.

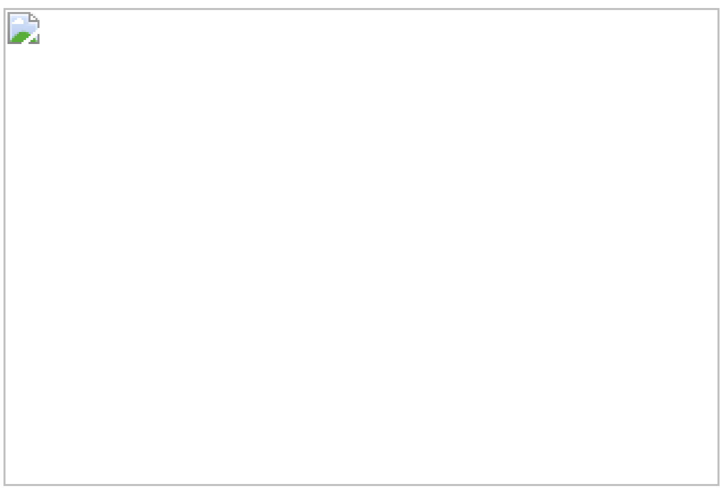
Repeat this process on the other end, securing the wood handles to the bending strap. Once completed, give them a pull and check that they do not come loose or wiggle while being stressed. There is a good chance

they might be pulled during bending, so knowing they are strong is important.

The finished piece should look like the diagram above, with a good amount of bending strap between two wood handles on either side. Store it flat while not in use to keep it from becoming kinked.

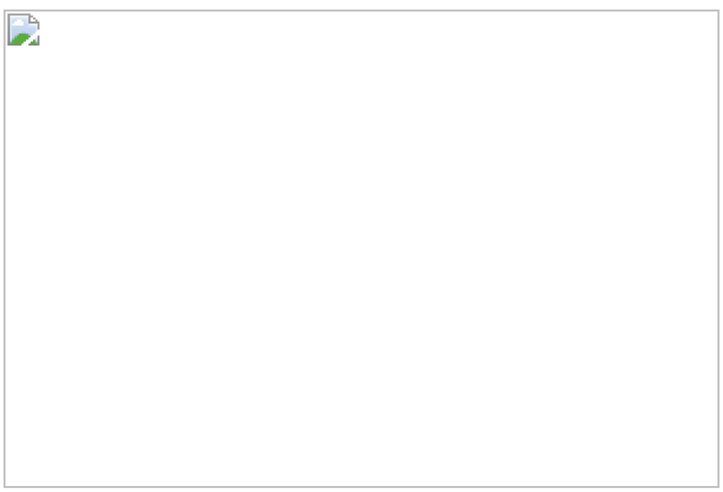
NECK SUPPORT

The neck support is a very useful item to have around for a number of tasks. Any time the neck of a guitar needs to be supported without damaging it, this piece will be valuable to have. It is made from scrap wood and a piece of thin cork. The cork is sometimes hard to come by, but it can usually be found in an office supply store. It is used to make cork boards, and comes in a large roll of about 1/8" thick cork. One roll will last a lifetime of guitar making, and will be used for clamping pads, and sanding pads as well. The thicker stuff may work too, but the thin kind works great.



Make the block from two pieces of 6/4 wood, or enough to make a block that is about 2-1/2" thick when it is done. The height may change according to taste, but mine is 5" tall and 3" wide.

Cut out the needed wood and assemble a rectangular piece that measures 5" x 3" x 2-1/2" like the diagram above. Glue it together and clamp it until dry. Draw a curve along the front face that is about 3/4" deep at the lowest point. This can be done using something round as a template, however doing it freehand is fine too. Cut out the waste portion on the band saw, and use a belt sander or curved sanding block to smooth out any rough areas. This does not need to be a very smooth sanding, because the block will be covered with cork. Remove any really bad places that will leave lumps in the cork, and then stop.



Cut a piece of cork that is a little longer and wider than the top of the support block, measuring with the curve to make sure the piece is big enough. Glue this piece to the top of the block with wood glue, applying a little more than normal to counteract the cork absorbing more glue. The waste that was cut out can be used for a clamping caul if it is still in one piece, or a can or bottle can work too. Do not clamp too tightly, only

enough to keep the cork from curling up. With a caul in place to hold the cork down, let the glue fully dry before moving on.

Remove the clamps after the glue has dried, and make sure the bond does not have any gaps or problems with it. Fix any if there are.

Using a razor blade knife, trim the excess around the edges flush with the block. Then, take some sandpaper and very gently round over the cork edges and blend them into the wood. If there are any bits of glue squeeze out, get rid of them too so they do not end up damaging a neck.

Inspect the cork lined area where the glue was and check that no glue seeped through the cork, making a hard spot that can be seen and felt on the surface. If this has happened, then a little too much glue was used, or too much clamping pressure was used. Either way, it is not worth trying to remove it with water or dig it out.

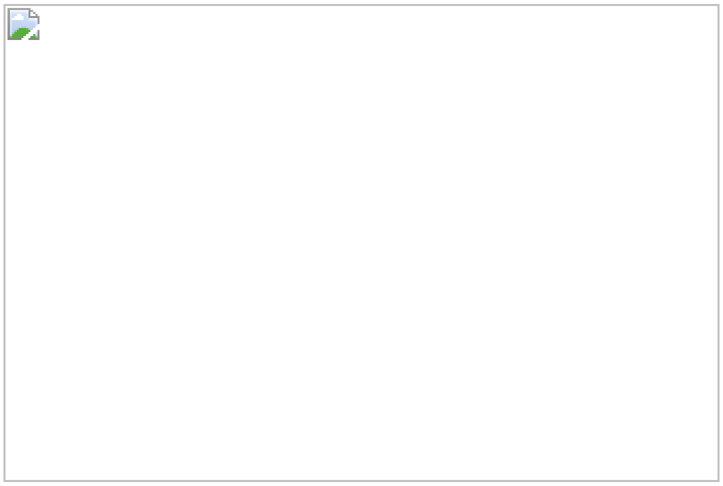
Cut another piece of cork, and glue it over the last one using a little less glue and little less clamping pressure. This time it should turn out fine, and can be trimmed and sanded like the last one.

This will keep the guitar neck upright and help prevent accidental damage while stringing or working on the body.

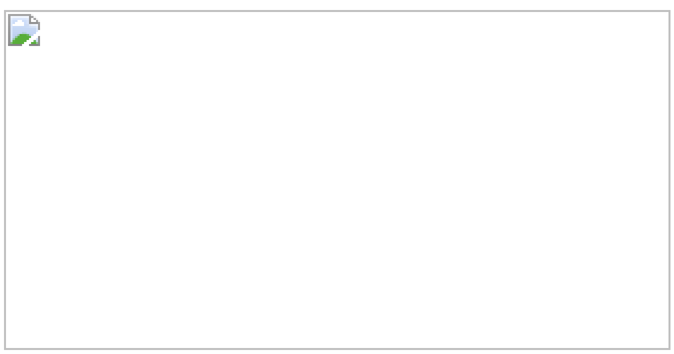
NUT SLOT CHISEL

When the nut is attached to the guitar neck, the slot must first be prepared. The slot must be free of glue squeeze out from the fretboard installation, and it must be level and flat. It must also be the right size to pinch the nut just enough that it remains secure in the slot. This can be difficult with a regular chisel, so having a specially ground chisel just for the purpose helps quite a bit.

The chisel can be made from an existing 3/8" or 1/4" chisel, and it does not require a grinder. The chisel must be shaped to match the size of the nut slot, which can be easily determined by measuring the size of the nut (usually close to 1/4") that is used. Most guitars get the same thickness of nut, so this tool works on just about all of them.

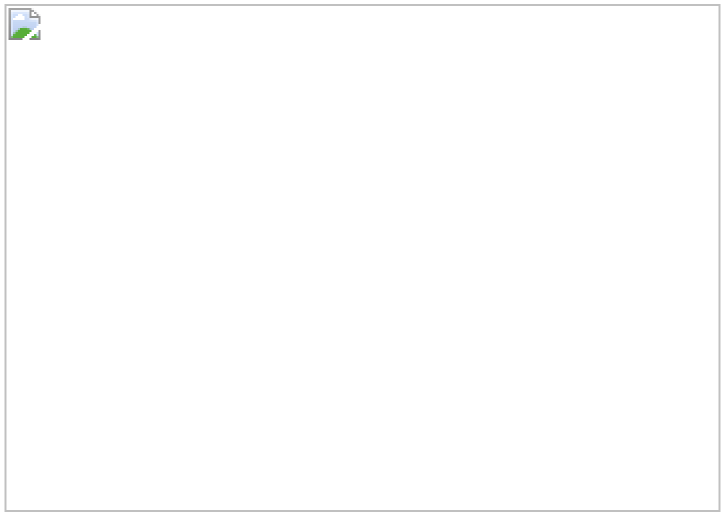


The last 2" of the chisel can be ran against a belt sander to remove the small amount of metal necessary to get it down to width. Do not leave the metal against the belt sander for more than a couple seconds at a time, stopping often to allow the metal time to cool. If the metal turns colors, it means the temper is gone, and it will require sharpening more often. The good news is that even of the temper is lost, this chisel only needs to do a little precision work once in a while, and will last a long time between sharpening either way. It is important that the metal being removed is taken from the sides of the chisel, and that it is checked often to prevent too much from being taken off.



The next thing that needs to be done to the chisel is to increase the bevel so the cutting edge is sharper. An extremely sharp chisel will work the best at removing the delicate amounts of wood in the nut slot. A dull chisel will tear the wood and possibly make even more work than it solves.

The above diagram shows two chisels. The standard chisel shape A has a steep angle, and therefore can only get so sharp. Flattening the angle like in chisel B allows the point to become sharper, and therefore it removes wood better.



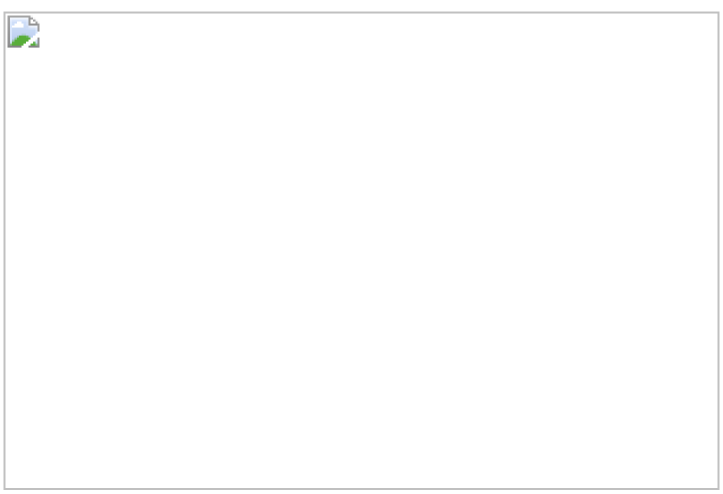
Use the belt sander again to remove the bulk of the material on the bottom of the bevel, giving it a shallower angle and thus a sharper edge. Remove the tool often to prevent ruining the temper, and check the new bevel often. Finish up with sharpening stones and hone the edge to a very sharp point. Again, given the delicate work it will be doing, the edge should last for a very long time before it will need to be sharpened again.

TALL TABLE SAW FENCE

The table saw is a very useful tool for guitar making, especially if the saw is a very tough and well made tool. For those of us who have a basic table saw, there are some modifications that can be made to increase its usability. The basic table saws being referred to here are hardware store saws, that are nothing more than upside down circular saws mounted to a table. These saws have very small fences, basic adjustments, and huge gaps in the table insert. The average table saw can benefit from some modification, but the basic table saw will really change for the better with some simple additions.

Basic saws have limitations that nicer saws do not, one of which being a strong fence that can hold large pieces of wood being sent through. The short fences have a hard time keeping stock vertical, especially when deep cuts are involved, like when splitting open a piece of wood.

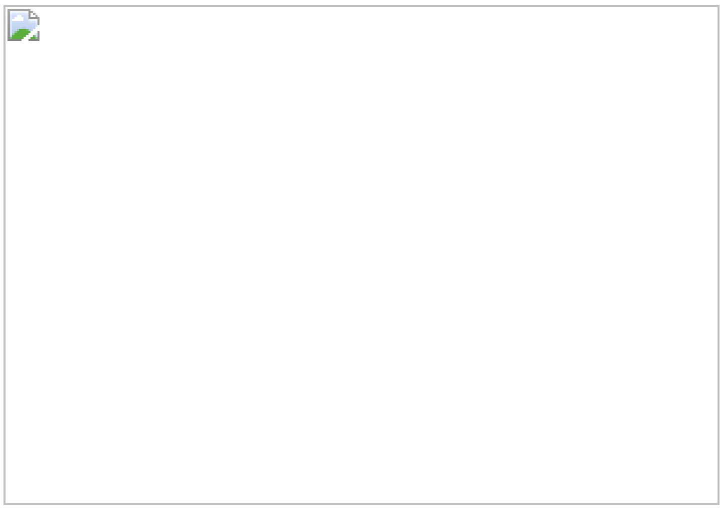
A simple modification can be made to the fence itself, that will make it larger, heavier, and less likely to move during use. Also, the height will make it easier for those larger pieces to stay vertical through the really deep cuts.



The simple addition of a large piece of MDF that is bolted to the existing table saw fence, will improve the functionality of the tool

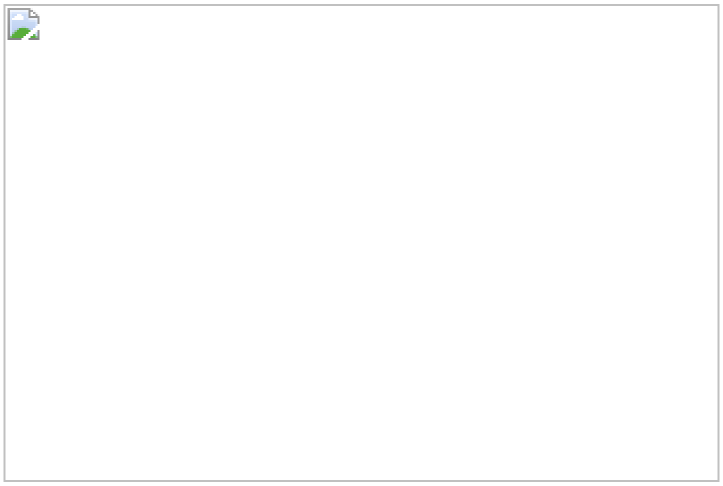
significantly. The piece in the picture is 10" tall, and as long as the table saw top, which is 20". The piece is 4/4 thick, so it is not going to bend or distort while in use, and it is very easy to install.

Cut a piece of 4/4 MDF to the needed dimensions depending on the table saw being modified. Make sure to measure everything from a factory edge, so that the edge riding along the table top is flat and 90 degrees to the faces. A crooked board will not stand up straight, and will make it a challenge to get it set up correctly later on.



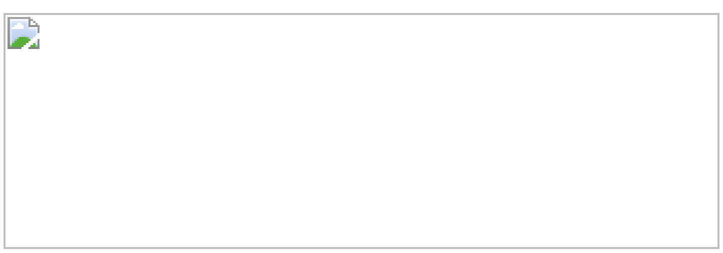
The next step is to figure out a way to attach it to the existing fence. In the case of this saw, there were already three holes on the fence, spaced equally from each other. These holes were big enough for a 1/4-20 bolt to pass through snugly. If holes are not there, it is a simple matter to mark and drill them on the fence.

Once the holes are in the existing fence, stand the board up next to it on the table saw, and clamp it there. Mark the location of the holes on the MDF piece while clamped in position, this way once they are drilled, the new fence addition will slide along the table top just like the old fence did. This will eliminate the chance of the holes being drilled too low, and the MDF floating in the air once screwed to the fence.



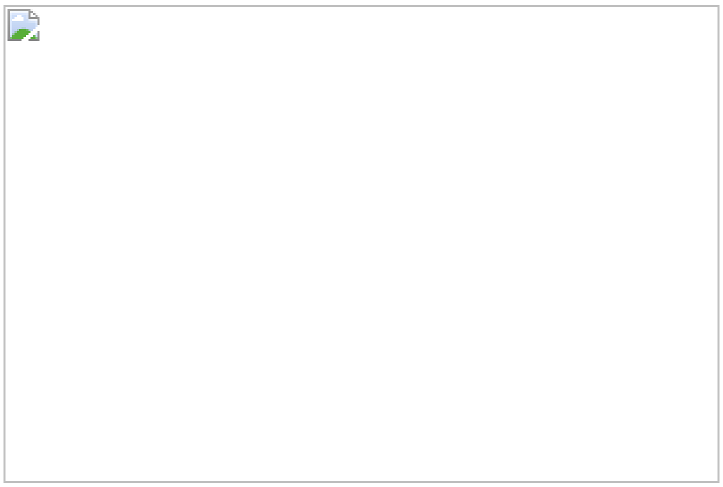
The heads of the bolts need to be sunk lower than the face of the wood, and the holes need to be drilled for the bolts to pass. The best way to do this is mark the hole locations using the fence as a guide, then drill a counter bore deep enough that the heads will be below the surface. After that, follow through with a drill bit that is big enough for the bolts to pass through snugly.

The reason to run the counter bore first, which is the Forstner bit, is that it is very hard to control the bit without something in the center where the pilot is. If the drill bit for the bolt was done first, there would be nothing for the center pin on the Forstner bit to grab onto, and nothing to keep it centered as it starts to bite into the wood. Clamping the piece down really hard is the only thing that can be done to keep the piece steady. After that, the counter bore can be drilled a little easier.



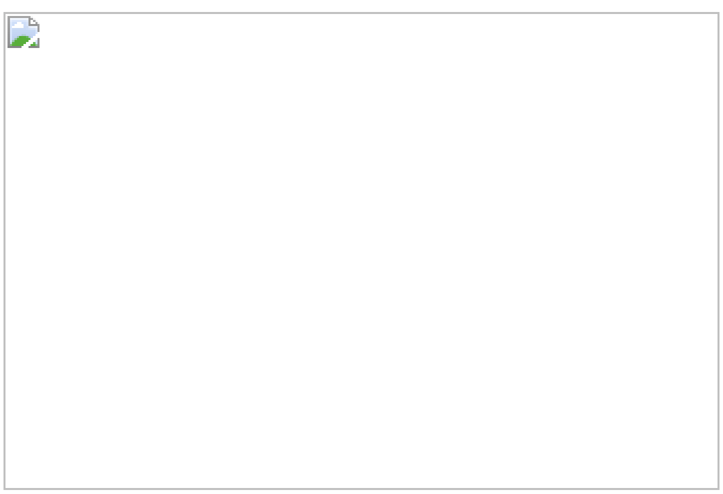
The above diagram explains those four steps a bit more. The first step is to mark the location of the hole at the center, and use a sharp tool like an awl or punch to make a small indent. This indent is for the drill to follow, and to help it get started. Step 2 is to drill with the Forstner bit,

and counter bore a shallow cylindrical hole where the head of the bolt will reside. The third step is to use a regular drill bit, and drill following the center mark left by the counter bore, and go all the way through the piece. Lastly, the bolt and the nut can be fastened through the hole. The bolt in this case needing to be long enough to go through the fence as well as the piece of MDF.



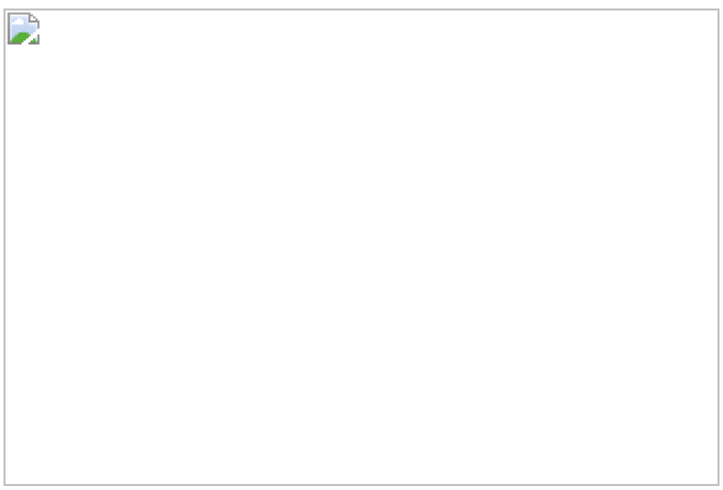
This picture shows the close up detail of the bolt head that has been recessed into the face of the new board on the fence. The bolt is far enough into the wood that it cannot interfere with the wood passing by it as the table saw is being used.

After the fence and MDF board have been bolted together, the next step is to check and see if they are square.



A regular metal square is used to check and see if the new board is square to the table top, and adjustments are made if necessary. The taller the square the better when measuring the MDF, because the top will show a problem faster than the bottom. A small degree of inaccuracy near the table top will end up being much larger by the time it reaches the top of the MDF fence.

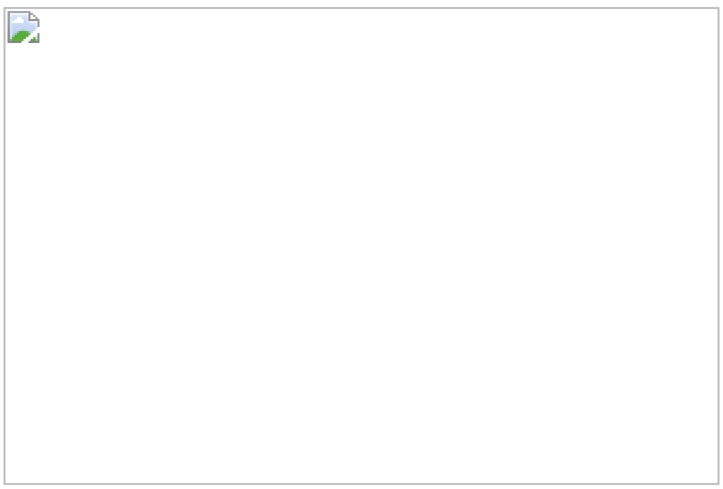
Set the square on the table top, and look to see if there are light gaps coming through. If there are, insert paper shims (scraps of folded paper or sandpaper) between the small fence and the MDF piece until the MDF is made to be straight. Small adjustments with the shims will make big changes to the entire structure. Continue to adjust the MDF until it is square, then lock the bolts in place snugly. Perform one last check with the square to make sure it has not moved during the tightening, and it is done.



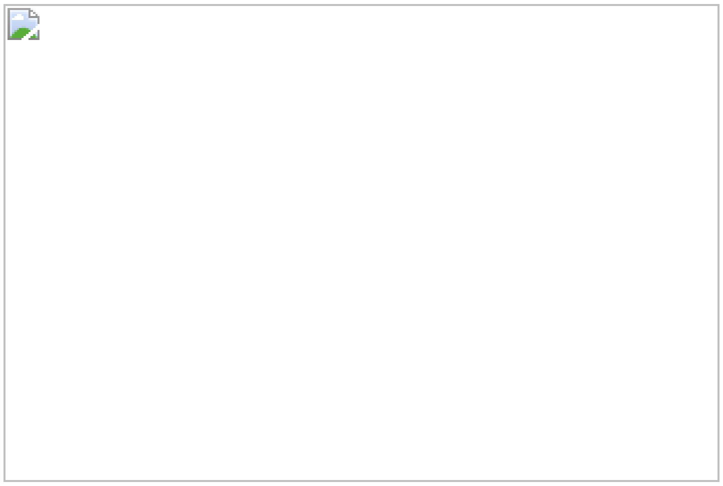
With the fence add on in place, the large boards will line up easier, and cut better. This is because as long as the edge of the board being cut is flush with the table top, and the face of the board is flush with the fence, a nice square cut will be the result. This makes the larger tasks of splitting wood easier, and even makes smaller cuts easier and more accurate.

CLOTHESPIN CLAMPS

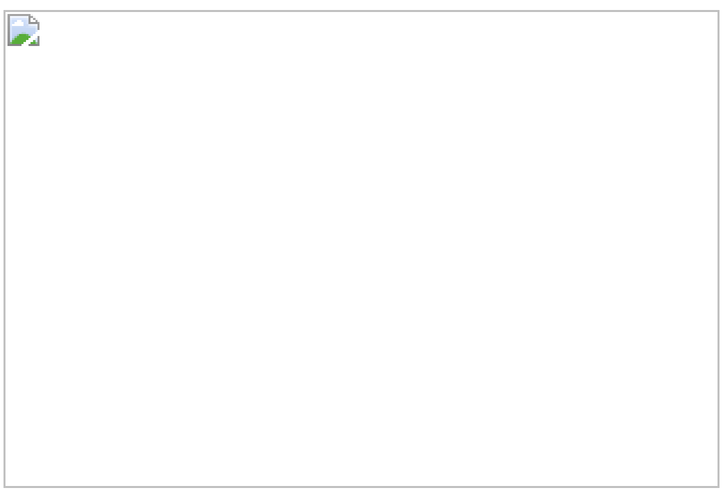
It takes a ton of clamps to attach the kerfing to the sides while being glued. Small spring style clamps can be purchased for this, however they can be fairly expensive once 50-60 of them are bought. A good alternative that will only cost a couple dollars is to use spring style clothespins and rubber bands. This will not only save money, but it will exert about the same amount of force as the small spring clamps.



Finding the clothespins will probably be the biggest hurdle in the entire project, because they are not used as much anymore. A store will normally have them in packs of 20-30 for a couple dollars a pack. Pick up around 80 clothespins, and a whole side of kerfing can be done at once.



The next item needed is a pack of rubber bands. These should be fairly thick, and easy to stretch because they will need to go on every one of the clothespins. Wrap one rubber band around each of the pins just like the above picture, and the effect will be to increase the clamping pressure the pins can apply. Keep the band a little back from the jaws so there is room to get the side of the guitar and the kerfing deep into the jaws. Place them just behind the circular opening, and near the metal spring clip. The further forward (closer to the jaws) the bands are, the more force they will clamp with. The further back towards the middle of the spring clip, the less force.



The clothespins are made from pine or other softer and cheaper woods than guitars are made out of normally, so there should not be any issues with them dinging or denting the sides while being used. With glue

between the kerfing and the guitar side, apply the clamp like in the picture and it will hold the kerfing in place very well. It will take several dozen of these small clamps to do an entire guitar side, and they can all be saved in a plastic shopping bag while not in use.

Project Notes:

The back of the guitar presents a little more of a challenge than the top, since the plate is bent into a curve. The height of the sides at the neck is smaller than the height of the sides at the end pin. This can cause a problem when trying to wrestle a piece of straight kerfing onto a piece of wood that is curved.

Using a few bar clamps can really improve the performance of the small clothespin clamps, especially if they are placed in the areas where the bend takes palace. The waist of the guitar is usually where the back plate starts dropping off, so a bar clamp in this area will hold the piece and keep it from twisting while the rest of it is clamped.

Once the couple bar clamps are doing the heavy lifting, apply wood glue to the rest of the strip and continue to use the clothespin clamps. Place them as close as possible to one another, so that the kerfing strip is glued down as evenly and as thoroughly as possible. Loose kerfing means buzzing, and possible structural problems down the road, so apply as many clamps as possible.

FRETBOARD DUPLICATOR JIG

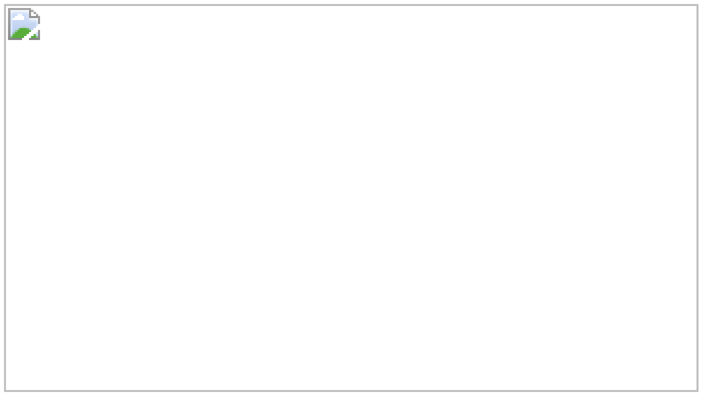
One of the most important tasks in making a guitar is the placement of the frets. Those metal bars determine the note being played, and have to be in the correct position. Measuring and cutting each fret slot one at a time is a very laborious and tedious task, and one slip in concentration can ruin half an hour worth of work. The alternative to this is an expensive store bought jig that will do the same thing, with a template and with far more accuracy. The template however is only good for one scale length, which is not very helpful if there are several different types of guitars or basses being built.

The fretboard duplicator is a shop made jig that will most likely cost nothing but scraps and some time, and it can duplicate any fretboard and scale length used in instrument making. This means that once the jig has been built, it can literally take any existing fretboard and make an exact copy of it.

This is a copying device, so it does require a slotted fretboard to work from. Many luthier supply houses sell fretboards that are slotted and flat, in a number of scale lengths. The important thing is to get a board that has the slots already cut, and has NOT had the radius or taper put on the board. The duplicator works best with a flat fretboard blank that has only had the slots cut, and no other work done to it. Pick up one that has the needed scale length on it, and others can be bought later as they are needed.

The construction diagrams will look slightly different from the model seen in the pictures, because there have been a few improvements to make the unit look better. The functioning will still be the same, but the jig will look a little less like it was cobbled together from junk found on the floor...which it was. The diagrams show a more refined and civilized jig that will be a favorite in the shop for a very long time.

The basic construction of the jig is like making a miter box for use with a hand saw. The diagram below shows the basic construction of the jig, with all the needed measurements.

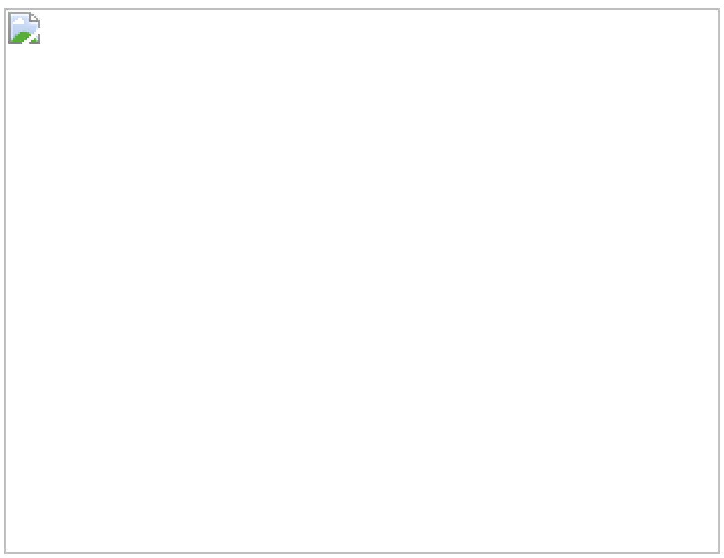


Begin by constructing the miter box out of scraps of plywood or MDF. The piece for the bottom must be flat and square in order for this to work properly. Take the time and construct everything cleanly and squarely. The first diagram shows a three dimensional view from the side, showing the measurements of the pieces. The second diagram shows a top view, again with measurements. Feel free to flip through the pictures to see how it all looks together, which will help with construction.

The pieces can all go together with wood glue and some screws, however be careful not to bulge the wood inside the jig, because it needs to be square to function. Keep all wood screws out of the area marked with the dotted line, and wipe up all glue squeeze out in the middle area of the jig.

After the main body has been constructed, it needs to be cut on the dotted line that is seen in the diagrams. This cut has to be dead on 90 degrees to the horizontal walls of the miter box. The best way to do this is to set up a chop saw or a radial arm saw for the job. Run a couple test cuts on some scraps and check the alignment of the blade with a square. Once an excellent piece comes out of the tests, cut the miter box into two pieces, making as smooth of a cut as possible.

The jig should now look like the above diagram, being in two pieces, and the cut being completely square. Set these aside for the moment, and proceed to the next step.



The way the jig works is by having a thin piece of metal on the bottom of the miter box, and that piece is perfectly aligned with the saw coming from above it. That is how the jig duplicates the board below it.

This index plate needs to be made from metal, and be the same thickness as a fret slot. There are many options out there for index plate material, and they include thin cabinet scrapers, pieces of sheet metal, a stack of feeler gauges, and really any other thin piece of metal that fits neatly into the slot. The process is the same no matter what is used for the indexing plate, and as long as it fits into the fret slot well, it will work fine.

The original jig was made using a razor blade, so that is how it will be explained here.

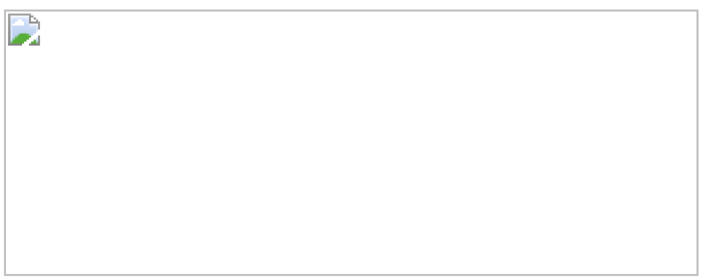
Depending on the thickness of the blade, which can vary from maker to maker, a single blade or a pair of blades will need to be used to make the index plate. These blades also have a hole in their centers, which will make it easier to get them secured into position.

To start, remove the sharp edge from the blade using either a dremel tool and a cutoff wheel or a belt sander. Do not cut this off with a wire cutter or similar item because it will bend the metal. The blade needs to be perfectly straight once the sharp edge has been removed. Test fit this into a fret slot in the master board, again to make sure it still fits well.

The next step will be to get the razor blade into position, and screw it in place. Grab the larger half of the miter box made earlier, and orient it so the end is facing forward like the diagram on the previous page. This is the end with the X on it, and this is where the razor blade will be screwed into position.

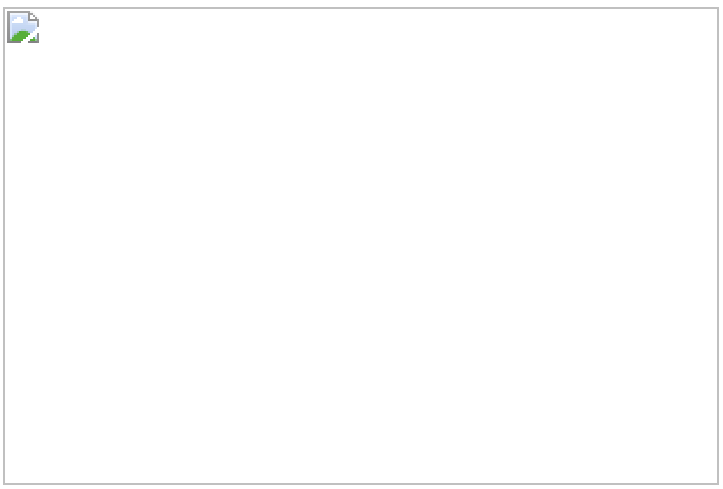
Since the spine on the razor blade is bigger than the blade itself, the wood in this area will need to be removed. The diagram shows this area as a gray box around the spine of the razor blade. This wood must be removed on both sides of the miter box faces, so when they meet, the only thing preventing them from going completely together is the thickness of the razor blade, which is the same as a fret slot.

Once the wood removal has been taken care of, screw the razor blade in place using a wood screw, and be careful not to put it in so far that it bends the blade. 1/8" of the blade should be sticking out above the bottom of the miter box. This should be the same as the depth of the fret slots on the master board. Check the fit again by putting both faces together, and remove a little more wood from the opposite end for the screw head to clear.

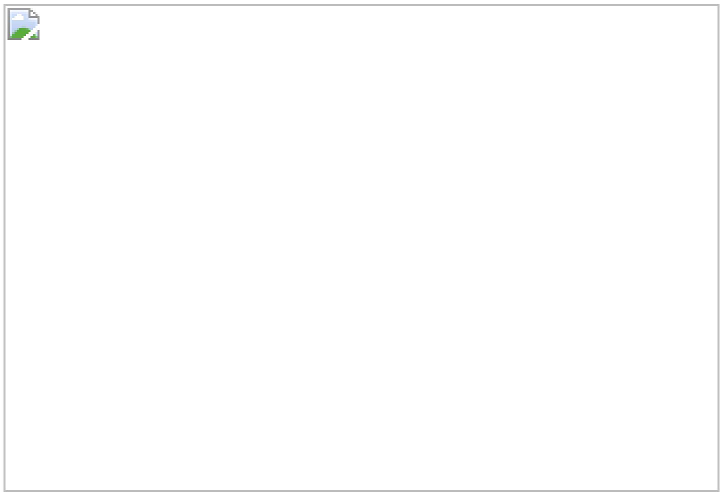


The faces of the miter box should be able to go together like the above diagram. The small index plate is the only thing keeping the faces from coming completely closed together, and the blade sticks up about 1/8". If the fret slots in the master board are not that deep, they can be made deeper by using a fret saw, taking them a little farther than the factory. The deeper the pin can set into the board being copied, the better it will keep locked into position.

Now that the miter box is ready, it needs to be secured to a base board. The function of the base board is to keep everything in alignment while in use, and to add a lip all the way around the box for clamping to the bench. Select a piece of 14" x 6" plywood or MDF for the base and cut it to size.



Put both halves of the miter box together on the base board and center them so there is an inch of overhang on all sides. Put the fret saw in the slot with a piece of printer paper on each side of it. This will add a little space between the saw and the miter box, so when the paper is removed the saw can slide back and forth without getting stuck.



Clamp the faces of the miter box together, which will keep the saw and the paper locked in position. Clamp them so they do not move around but do not clamp them with a ton of pressure, otherwise the saw will be stuck even after the paper has been removed.

Next, clamp the miter box assembly to the base board, keeping it centered. Once everything is clamped as described and in the last picture, the miter box can be screwed to the base board.

Pre-drill two screw holes at each end of the miter box, as well as two holes on each side of where the two halves meet. This will be a total of eight screws to hold it in place. Countersink the holes below the surface of the wood, and screw them in while everything is still clamped.

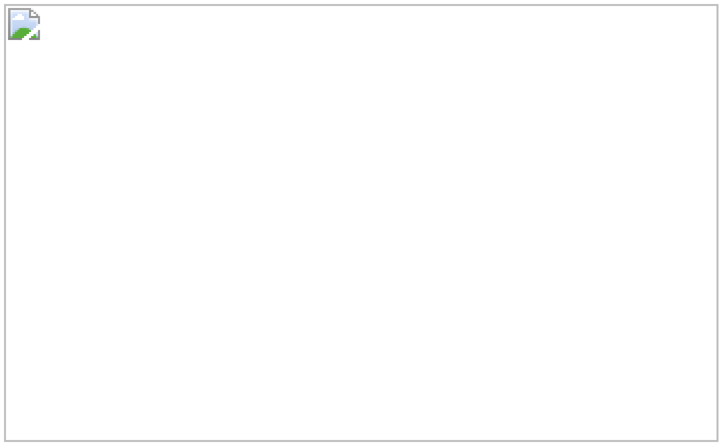
Once the screws are in, remove the clamps, the fret saw, and the paper, and see how it looks. The saw should be able to slide easily into the slot, but not have too much wiggle in it. The whole point of this jig is that the saw cuts straight on top of where the index plate is. A saw that wobbles all over will not do that, which means the jig will need to be adjusted.

A loose slot can be fixed by drilling the screws closest to the center joint in a little further. Try a quarter turn on each one, and test the saw again. If that does not do the trick, remove the screws, rotate the base board 180 degrees, and clamp/screw it together again. Keep working at it until the slot is nice and snug, but not so snug that it is hard to saw with.

With the clamps gone and the fret saw removed, the whole jig should look something like the above picture. The screws are all sunk below the surface, the slot is tight enough to keep the saw from wandering, and the base board gives a lip where the jig can be clamped to the bench while being used.

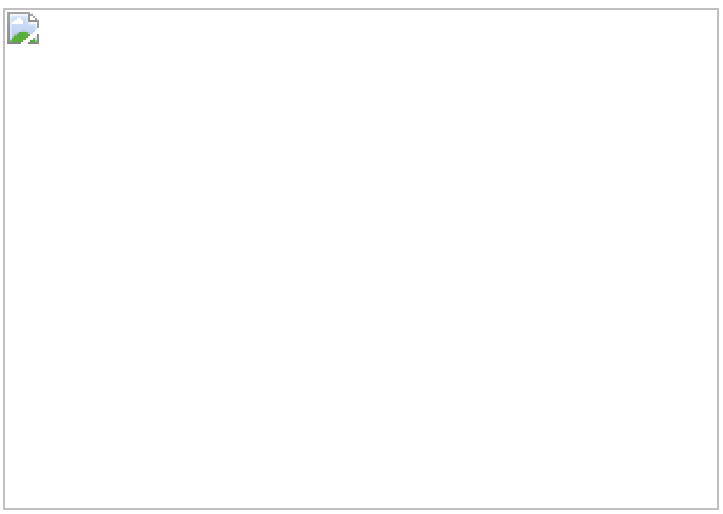
The last step is to gather up a fretboard blank and an already fretted master board, and start using the jig. The fretboard blank needs to be machined flat, cut to width, and squared on at least one edge. This edge will ride along the closer wall of the miter box while the slots are being cut. The width of the board needs to be the same as the master board being copied, because they will be taped together.

The diagram shows the two ends that need to be square to each other to make the jig work. The nut end is the main zero point on any fret scale, this is why it is so important to have it correct at this stage.



Tape the fretboard blank on top of the upside down master board. A piece in the uncut area of the first fret and another at the other end of the board will hold them together. It is important to line up the nut ends exactly, and keep the edges together as the tape is being applied.

The orientation of the two boards should be the master board on the bottom with the slots facing the bench, and the blank on top with the side to get the new slots facing up.



Insert the taped blank by setting it on the miter box on the left hand side. Push it under the area the fret saw goes, and let it slide along the index plate. Once the index plate finds the first fret slot on the master board, the master will drop onto it and be unable to slide any further. The index plate will be fully within the first fret slot, and the fretboard blank will be

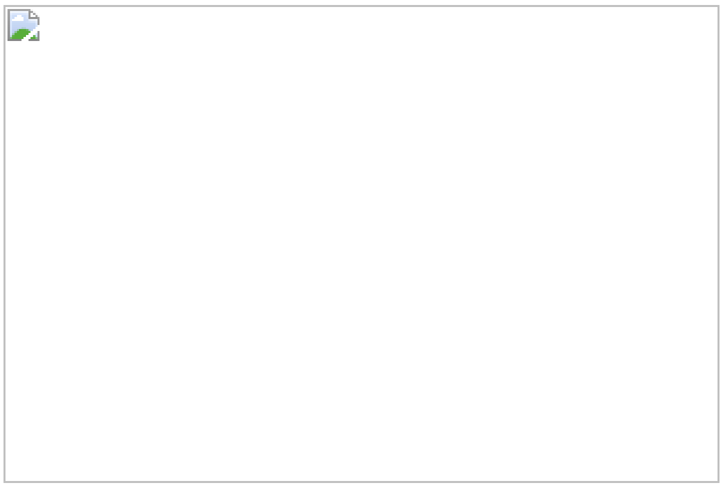
ready for the first slot to be cut. Be sure the close edge of the fretboard is held tightly against the inside edge of the jig, keeping it square to the index plate.

Take the fret saw, insert it into the jig, and begin sawing the fret position. Saw only about half way through the board, stopping to check progress if need be. Counting the number of strokes it takes to reach the desired depth will help speed the process up, because there will be less checking. Count the number of strokes, stop cutting, lift the boards and slide them to the next fret position, and saw again.

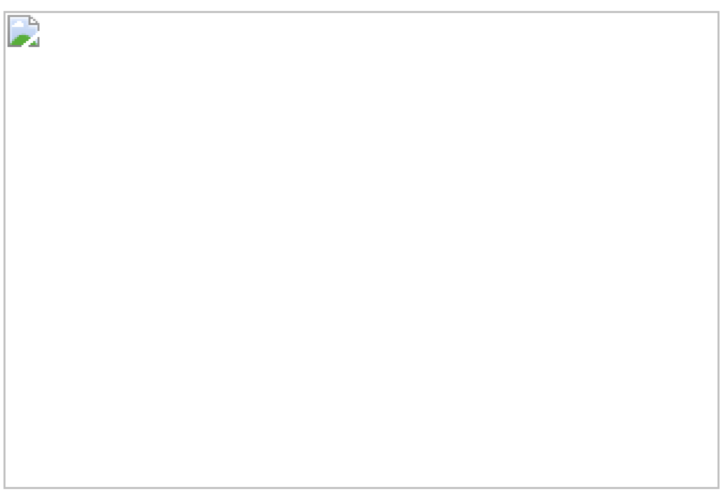
The picture above shows the first and second fret slots have been sawn. The board is picked up and advanced to the next slot until the entire set of slots has been sawn.

This is a far more accurate and reliable method than measuring and sawing the slots each time. It still does take a little time to saw each slot, however it is still far less than the alternative.

The reason there is not a depth stop on this jig is because depending on the size of the master board or the fretboard blank, they most likely will not be the same thickness. This would be a problem for a depth stop of any kind because it would go deeper on thicker boards and shallower on thinner boards.



After all the fret slots have been cut, look at the edge of the two boards and make sure they all line up nicely. If they do, and they should, remove the tape and either use the board immediately or make a few more while the jig is ready to use.



While the jig is out and ready, it is a good idea to saw up a few fretboards and have them ready to go when needed. All these fretboards were done in a matter of minutes, because this jig works so quickly while still maintaining accuracy. This is the quickest hand method of sawing fret slots, and the most versatile because any fretboard can be duplicated.

FRET SAW DEPTH STOP

When using a fret saw to make slots on the fretboard, it can be difficult to get to the correct depth every time. Going too shallow means frets that can never be hammered in all the way, and going to deep means seeing too much fret slot on the ends of the fingerboard. Both of which are easy to see on the finished guitar, and are easy to avoid.

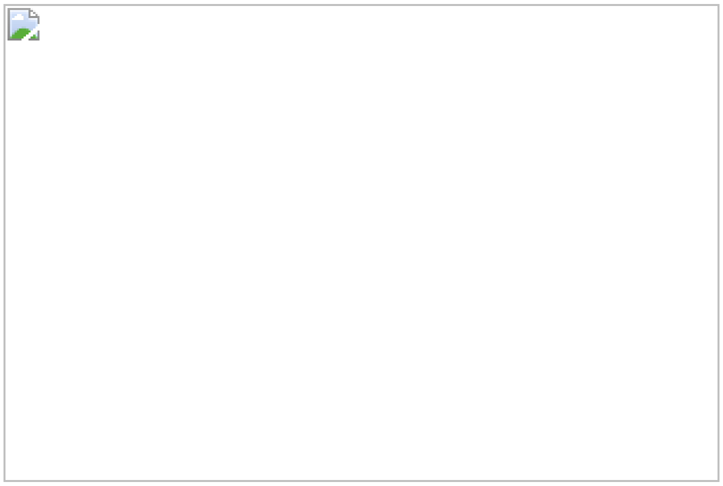
A simple yet very effective fret saw depth stop can be made by attaching a piece of thin wood to the fret saw, using the holes that are already in the saw from the factory. This piece of wood can be scrap, though a spare fretboard blank that has not been slotted or had the radius put on it will work well too.

Find a piece of wood that is about 1/4" thick, a little shorter in length than the fret saw, and a couple inches tall. The height needs to be 1/4" shorter than the distance from the teeth on the saw to the spine, since the wooden guide will need to be screwed to the side of the blade. This will be the blank used to make the guide.

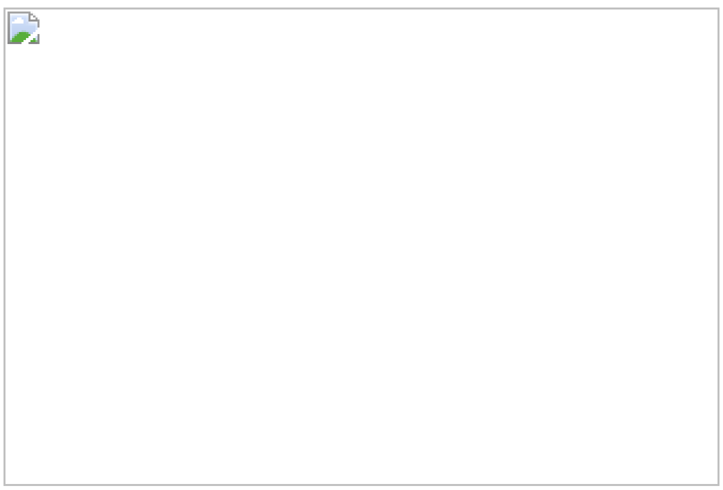
Decide which of the two long edges will be the bottom edge, and level it on a piece of sandpaper or on a jointer. Measure from the throats of the teeth to the center of the holes on the saw, and mark two points for drilling on the guide piece. Drill these a few sizes wider than the screw to be used, to allow some wiggle room for adjustment.

Attach the depth stop to the saw blade using a couple machine screws and nuts. Tighten by hand at this point. Take a piece of flat fret wire and line it up against the teeth of the blade, to check the depth of the tang. Slide the guide down to meet the fret tang and then tighten the screws down fully.

If right handed, attach the guide on the part of the saw facing left while using it. If left handed, attach it to the right side while in use. This makes it much easier to see the guide working, and know when to stop.



The saw and guide should now look like the above picture once the measurement has been made and the saw is ready to cut.

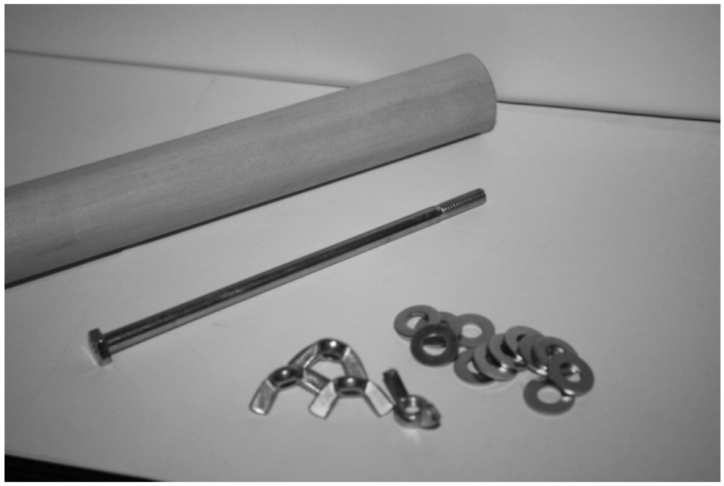


To use the depth guide, insert the saw into one of the slots in an already slotted fingerboard and being sawing. The guide will make contact with the fretboard once the correct depth of the slot has been reached. Do this on a test board once before slotting the actual board, that way a test fret can be hammered in to verify the depth is correct.

SPOOL CLAMPS

When gluing the plates to the sides, several clamps are needed to spread out the pressure and hold the pieces together. Especially if using an inside mold, spool clamps are an inexpensive and effective way to clamp the guitar, and they can be made right in the shop.

The spool clamp consists of a metal bolt, a couple wooden cauls with cork faces, some washers, and a wing nut. The metal bolt holds everything in place and acts as the spine of the clamp, while the cork covered wooden cauls exert pressure on the joint. At the top of the clamp, the wing nut is used to set the clamping pressure, which can be easily tightened or loosened.



When buying materials, it is useful to know how long the clamps will need to be, which is the height of the sides, plus the width of the cauls, plus about an inch for loosening and tightening. If the cauls are always made at one inch, it would serve that a 5" guitar side would need an 8" bolt. This is 5" of open clamping area, plus 2" for the two cauls, and 1" for the threads and extra room.

These can be made with bolts that are threaded the entire length, though they will have to be handled carefully when installing so they are not knocked against the sides, leaving thread marks. At the point the sides are clamped on, there will still be much sanding and scraping to be done. A few small scratches from the threads will not be terrible, but should be avoided if possible.

The washers can be standard size, or they can be the larger fender washers if desired. All the bolts and wing nuts in this example are 1/4-20 size, and the dowel is 1-1/4" wide. Purchase a long dowel of the same diameter, or even a 1-1/2" wide piece will work too. Purchase a set of bolts that will do the shoulder area of the guitar, as well as some longer ones for the lower bout, which will be taller.

First, cut the dowel to lengths of one inch, making sure to cut as squarely as possible. If using a band saw, use the miter gauge, though a miter saw would be best for this purpose.

If the end is not square on the dowel, cut it square first as seen in the picture above. Then, proceed to cut off several segments that are 1" long from the dowel. Each clamp will need two, so cut as many as will be needed, plus a few extra just in case some do not make it through the building process.

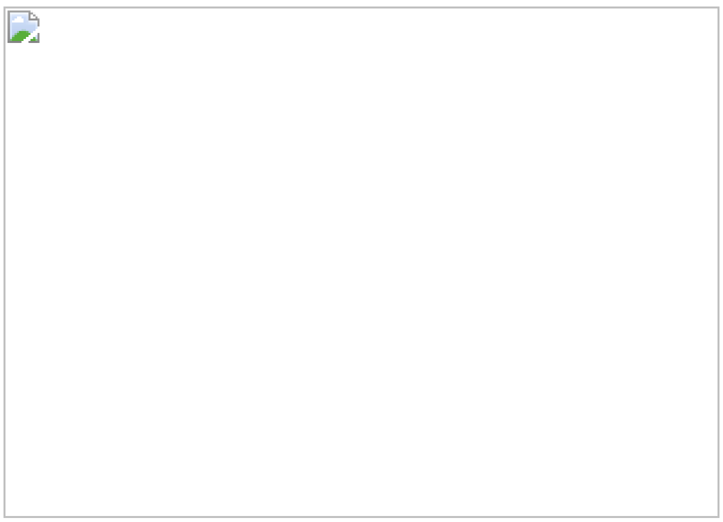
Using the belt sander, or with a piece of sandpaper laid on a flat surface, sand the ends until they are smooth, and free of large defects. It does not matter if they are not entirely perfect, the point is to remove any deep saw marks and generally flatten out the faces.

If the pieces were cut on a saw using the miter gauge, there should not be much of a need to sand them square. A light sanding to remove the scratches is all that will be needed, being careful not to ruin the flat faces. Uneven cauls will not grab well, and can slip off the sides of the guitar while clamped.

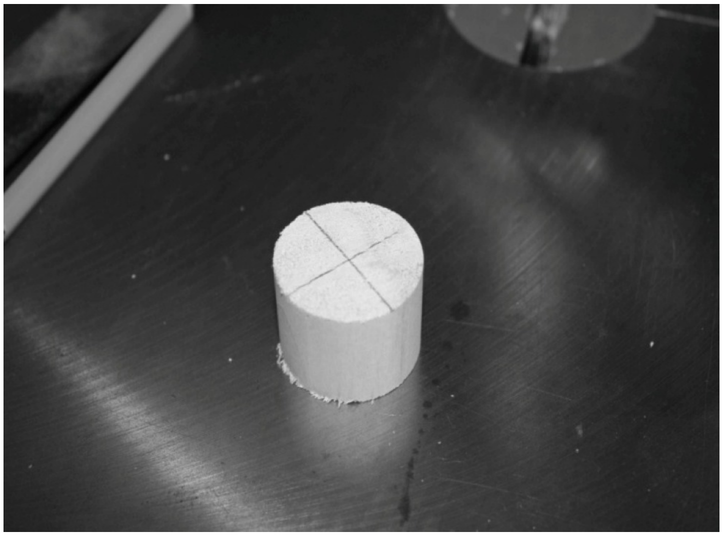
Using a combination square with a center finder for circles, line up the pieces and mark out the centers. This will only need to be done on one side, and it is for the drilling that will take place later in the build.

A center finder for the combination square is a great tool to have when marking the centers of round objects. If this is not available, try to make a mark freehand in the center. If it comes out uneven, mark the new center, then erase the old one. Once a good center is found, drill that caul first once that step is reached, and use it as a guide to drill the rest on center. This way only one will have to be marked correctly freehand, which can be hard.

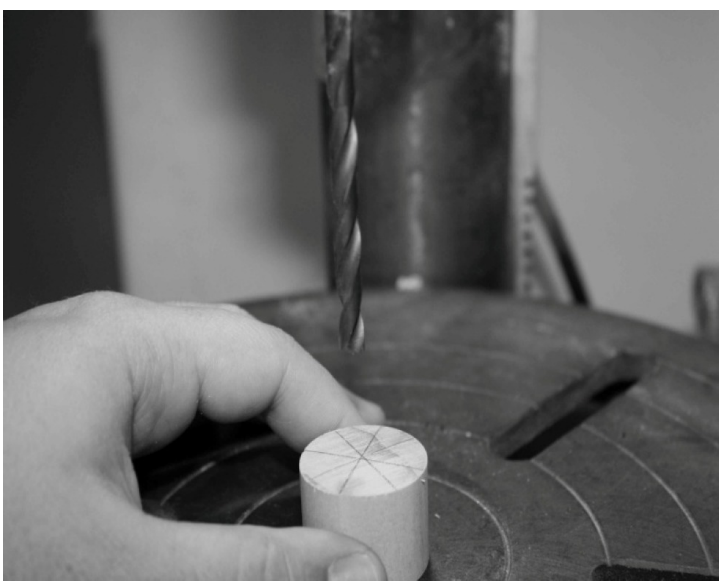
To use the first caul as a guide, place it over the top of the caul to be drilled, and pass the drill through the hole in the top caul and then into the undrilled caul below. Clamp the two pieces together to help keep them aligned, then clamp another undrilled caul in place and continue to drill all of them.



If using the combination square, mark one line across the piece, then rotate it 90 degrees and make a second mark. The intersection point of these marks will be the center of the circle, and this is where the piece will need to be drilled.



The picture above shows the caul after it has been marked with the combination square. A set of two lines that are perpendicular to each other are made to intersect in the middle, locating the center accurately. If using the combination square, the earlier method of using the first piece as a caul is still an option, however in this case all the cauls will be drilled individually on the drill press, and marked individually as well.

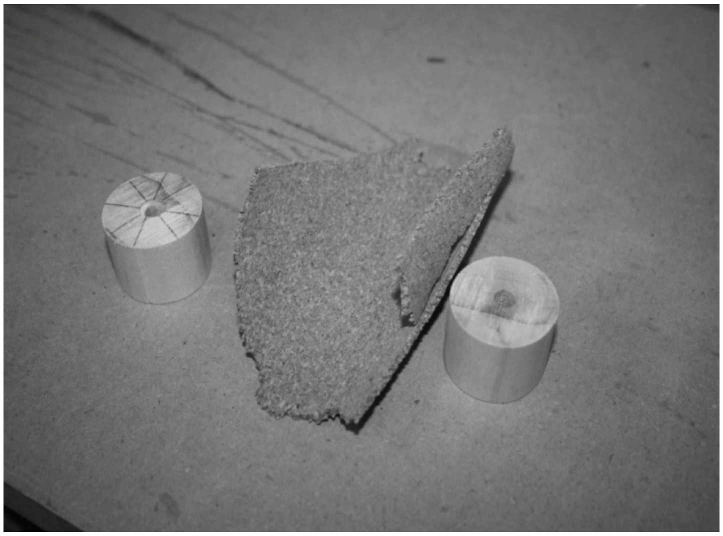


Chuck a drill bit that is the same size as the bolt being used, which is important for keeping the cauls from rattling around. If the caul

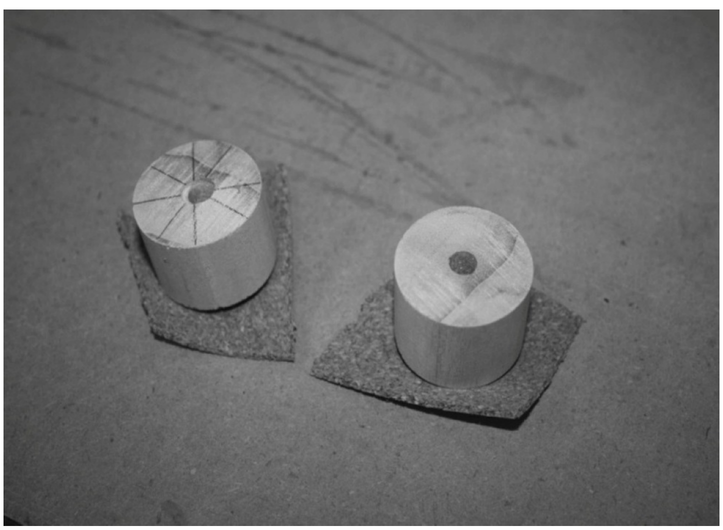
can twist and move around when the pressure is applied, it will most likely fall off the piece, and not be a very effective clamp.

In this case, the bolt size is 1/4-20, which means that a 1/4" drill bit is used to drill completely through each caul. Be sure the caul is placed over an opening in the drill press table when drilling like this, in order to ensure the bit pops out the other side and does not hit the metal table top. A scrap piece of wood can also be used under the caul, which will be felt once the drill bit punches through the main piece.

Drill the first two cauls and test fit them on the bolt. The caul that is pressed all the way to the head of the bolt should be a fairly stiff fit, which is fine because it will never move from the position it is in once the clamps are made. Check that the fit is snug, and if it is, proceed to drilling the rest of the cauls. Carefully drill through the center of each piece, though if the holes end up a tiny fraction off of center, it will not matter very much. If they are way off however, the piece should be discarded and another one drilled.

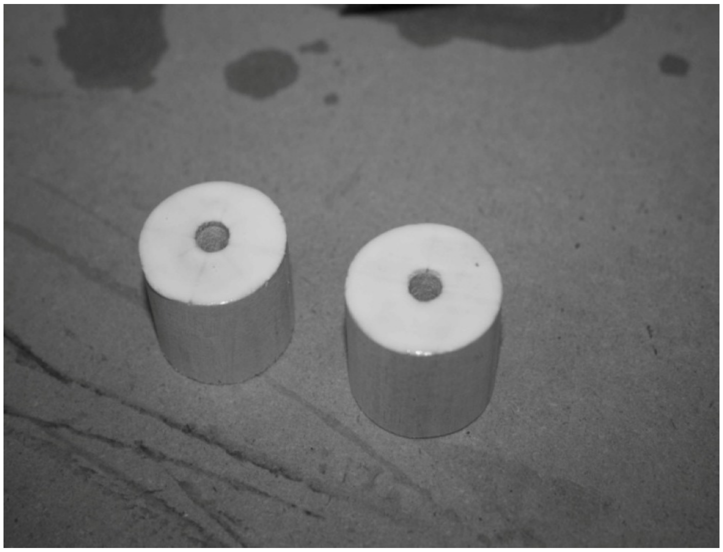


Once all the cauls have been drilled, it is time to cover the one side with a piece of cork. Large sheets of cork can be found in any office supply shore, usually somewhere near the cork boards. The kind that works the best is the thinner type, where the thickness is closer to 1/8". They come in rolls of several feet, and one roll will last a decade even in the busiest shop.



Use a razor blade knife or a scissors to cut out roughly sized pieces that will cover the faces of the cauls. Only one face will need to be covered on each caul, since the other face will be on the outside.

Try not to tear the cork because if it is dry it can crumble easily and crack. Cracks will allow glue to seep through the cork, which can cause hard spots, and mar the soft wood of the guitar top. Cut as many pieces of cork as there are cauls, and gather them all up together in a place where they can be glued and clamped for a few hours.



Apply glue to the tops of the cauls, trying not to get too much through the hole in the center. If some does get in there, just let it dry there. The pieces will be drilled out a second time later in the process, and the glue will be removed at that point.

Gym weights make excellent clamps for times when not a ton of clamping pressure is needed, but more of a hold down is required. In this case, the cork just needs to be held flat against the faces of the cauls so that it does not curl up while drying.

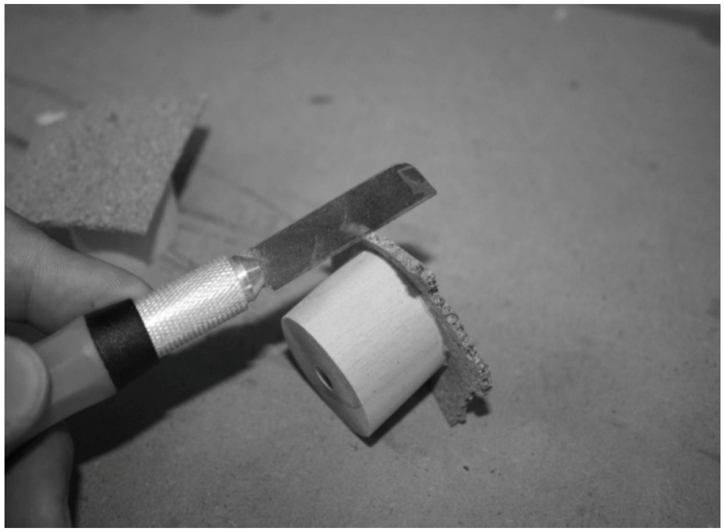
Look for a weight with a smooth face to lay directly on the cauls as they dry, and then stack any other weight on top of that first one. This way the cork cannot come off of the face of the caul.

Another way to keep the cork flat is to use a piece of wood that is flat, and any weighted object can be placed on top of it. If the piece is large enough, several cauls can be glued and clamped all under one piece of wood with several weights on top of it.

Gym weights can be found in yard sales, at second hand stores, or in discount stores for a very inexpensive price. If they are bought in a regular sporting goods store, they will tend to be more expensive. Several gym weights in the range of 2-1/2 lbs. to 10 lbs. are perfect for weighing down small projects like this.

If gym weights are not available, several bar clamps can be used to hold down the cork as it dries, though make sure the faces of the clamp are as large as the cauls, otherwise the ends may come up.

Clamp each one of them with light to medium pressure as the glue dries, and set them aside for several hours. Once the pieces have dried, the trimming and assembly steps can be worked on.



Once the glue has dried thoroughly, use a hobby knife or razor blade knife to trim the edges close to the wood. This does not have to be perfect, because it will be sanded later, however the better this part goes the less sanding will have to be done.

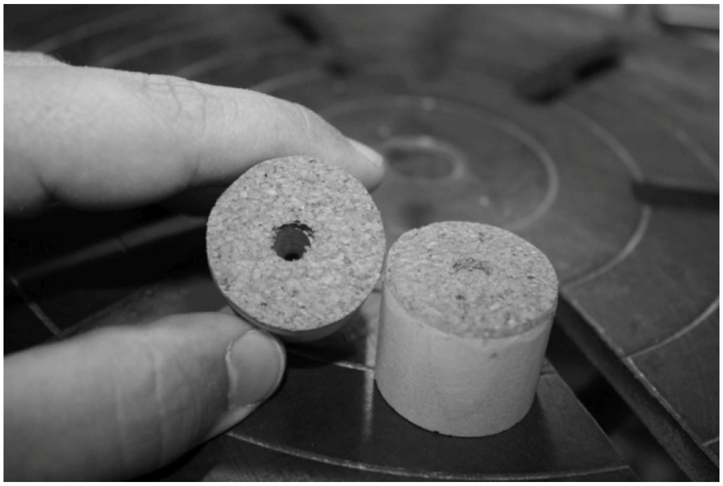
If a power sander is not available, spend a few extra seconds on each piece, making sure they are cut closely to the wood. Sanding by hand is more time consuming than cutting the excess off. However, if a power sander is available, cut fairly close then proceed right to the sander, which will be a much faster and cleaner way of getting the cork flush to the sides.

Once the bulk has been removed from the cauls, they will look like the picture above. A little overhang is fine, as the sanding process will

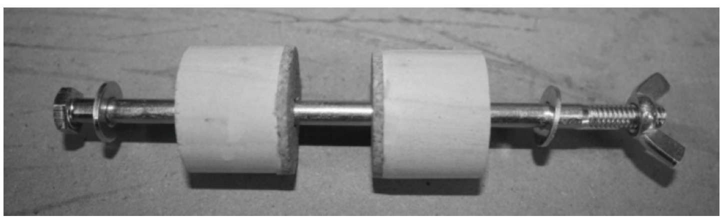
get rid of the rest.

Sand the edges using a power sander or a piece of hand held sandpaper, getting the edges of the cork flush to the wood.

With the edges all flush on each caul, drill out the centers again using the same drill bit. The goal here is to remove the layer of cork, and to drill out any glue that ran down the center hole.



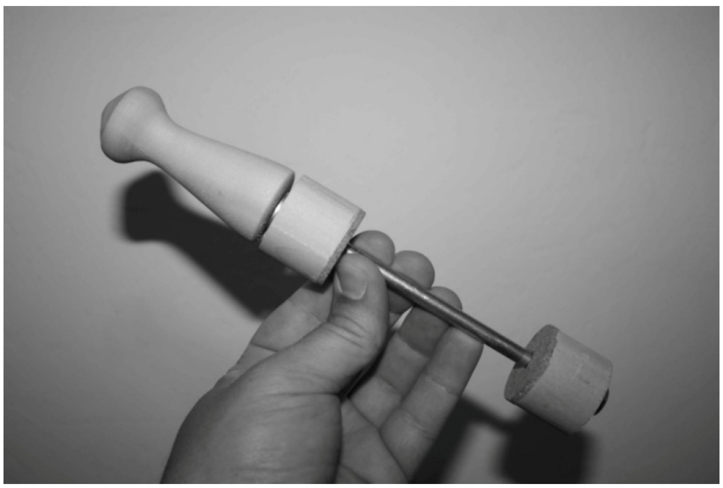
The pieces should now look like this, with the centers cleanly drilled out.



Line up everything as seen in the picture above, starting with the bolt and a washer, one caul with the cork facing right, another caul with the cork facing left, another washer, and finally a wing nut.

The clamps are used by placing the bolt portion right against the side, and twisting the wing nut until the cauls press against the plates. They will not take much pressure to hold, and several of them can be lined up to hold the plates to the sides while gluing.

Use the longer clamps for the lower bout, and the shorter ones for the upper bout and shoulder area of the guitar. If a clamp is not long enough and is missing the mark by a tiny fraction, a little of the bottom caul can be cut off the non-corked side, making the opening a little wider.



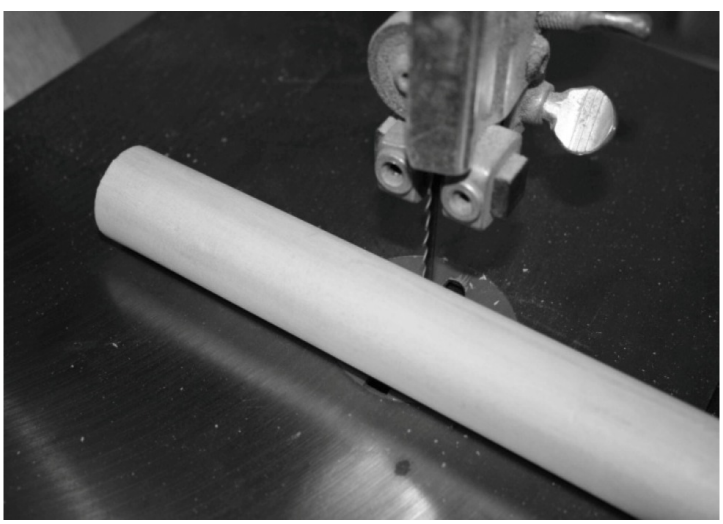
For folks who have a harder time turning a wing nut, or would rather have something more substantial to crank on while using their spool clamps, a simple handle crank can be made. These can either be made on the lathe as in this example, or made from short lengths of dowel rod, which is explained at the end of this section.

Since guitar making is a lifelong hobby, equal attention should be paid to the tools that are built in the shop. A well made tool will work better, be kept longer, and used more often than something poorly made. Spend the time to make a handle for each spool clamp because it will make the clamps look more professional, they will be easier to manipulate into position, and they will be taken care of better.

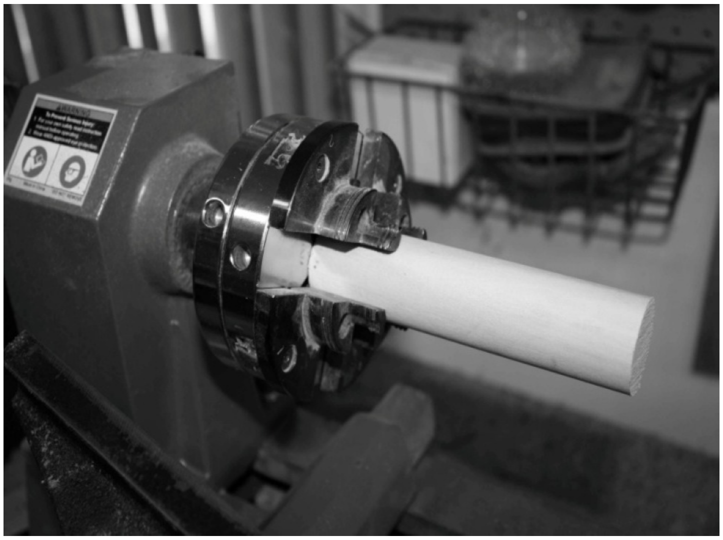
In order to make this piece on the lathe, a medium size chuck is needed, which will aid in holding the dowel as it is shaped. The chuck in the picture above is made for a midi lathe, and is sold by a large online pen turning supply company.

Select a set of jaws for the chuck that can grip the piece tightly by the end, and are also long enough to keep it straight while being locked into position.

The live center can be used in the tailstock to line up the piece perfectly straight by placing the tip of the center in the middle of the tailstock end of the piece, and then locking it in place with the chuck jaws.



Using the same size dowel rod that was used for the clamping cauls on the spool clamps, cut a length of rod that is 4" to 5" long, depending on how long of a handle is desired. If working close to the chuck makes you nervous, go with a 5" piece for a little more room to work.



Chuck the rod onto the lathe, making sure it is horizontal, using the jaws of the chuck to help line it up. Again, the tailstock and a live center can be used to guide the positioning of the piece, though a longer set of jaws will almost line it up automatically.

Rotate the chuck once the piece has been tightened a little, checking to see that it runs true, and there is not too much wobble. If the piece wobbles too much, loosen the jaws and reposition it. If the piece runs well, tighten the jaws a little more, which will lock the piece in place.

Put on a face shield and turn on the lathe for a couple seconds. Check to see that the piece is still running well, and if it is, then it is time to start the drilling process.

The two methods of inserting a set of threads into the handle that will not wear down like wooden threads, are a simple nut, or in this first example a threaded insert. The threaded insert is used by drilling a hole large enough to screw the insert into with an allen wrench, then a machine screw can be screwed into its center.

Make sure when buying the threaded insert that the thread pattern inside the unit matches the thread pattern of the screws being used. Often times it is best to get into the habit of buying any machine screws, nuts, washers, and inserts all at the same size, especially when the size really does not make a difference. In this instance, the inserts are 1/4-20, which match basically every other machine screw in the shop, as well as the bolts used for the spool clamps.

A Jacobs chuck will be needed at the tail stock end of the lathe, which will be used to drill out the hole in the center of the dowel for the insert. Select a drill bit that is a little smaller than the outside threads on the insert, and chuck it in the tail stock.

When selecting a drill bit, pick one that will clear a hole that is the same diameter or slightly larger than the barrel of the insert. This can be measured between the threads on the insert with a caliper, and the correct drill bit selected. This way, only the threads will be biting into the wood as it is turned into the hole, and it will hold on tightly while being used.

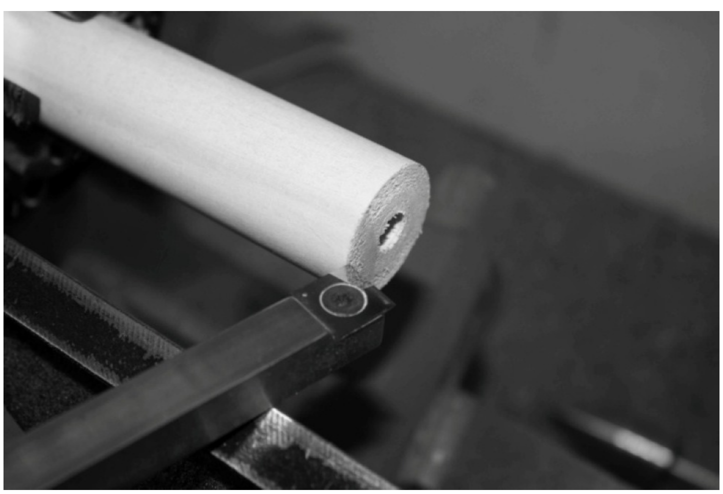
Turn on the lathe once the correct size bit has been chucked into the tail stock. Advance the tail stock as close to the rotating piece as possible, then lock it down to the bed. Turn the crank handle on the tail stock, advancing the bit forward, drilling the hole.

The depth of the hole should be a little longer than the length of the threads on the bolts used to make the spool clamps. This way, they can be turned all the way down if necessary to clamp a smaller piece.

Drill into the end of the rotating piece on the lathe, and retract the bit when the proper depth has been reached.

After the bit is retracted, and the lathe has been turned off, the fit of the insert can be tested. Just slip the end of the insert into the hole, which the barrel should slip in easily. Do not screw it in at this point, because the shaping that will be done later will not work with the insert in the way.

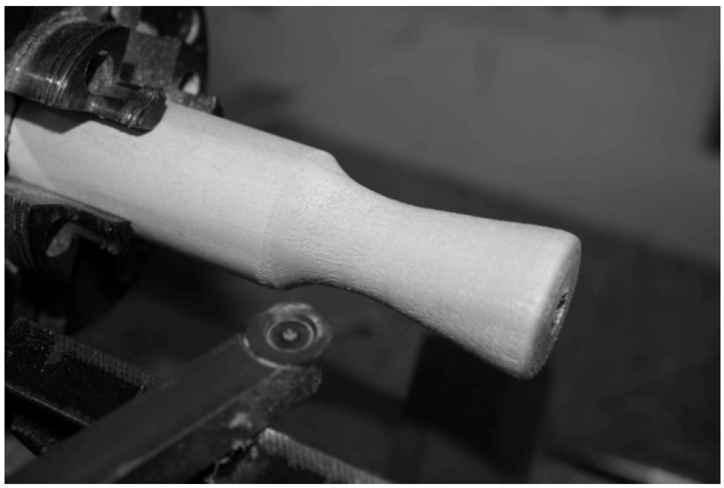
Check the depth of the hole with a toothpick or small piece of thin wood. Insert it all the way into the hole, and pinch it where it meets the top. Pull out the toothpick and measure it with a ruler, or simply check it against the bolt. It should be longer than the threads on the end of the bolt, or at least a little longer than the insert if using a bolt that has threads running the whole length.



The first thing that will need to be done to the blank while on the lathe, is to flatten the face where the insert will go. This is to make sure

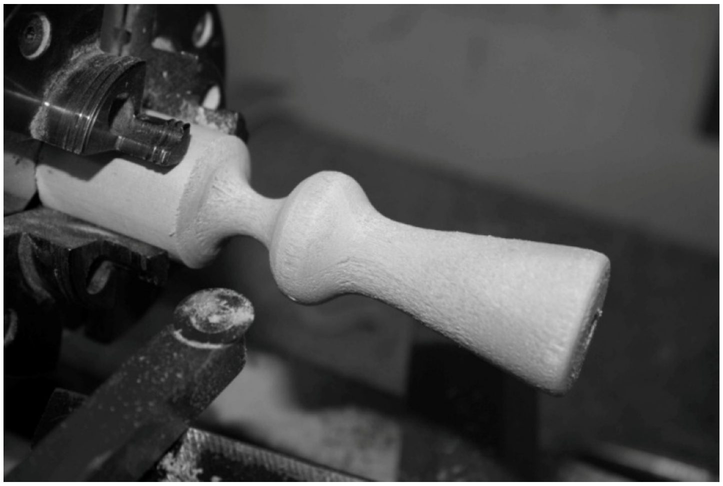
that there is even pressure when the handle is turned, and that the handle sits well on the spool.

Cut off an even layer of the face, making sure not to take too much off. If several tries are needed to get the face smooth, check the depth of the drill hole, as it may have become too shallow. In that case it will need to be drilled again. The face can be made flat, or it can be turned with a slightly convex face, where the middle is slightly higher than the outer edges.



Once the face has been shaped, move on to the rest of the piece. There are several handle styles that can be turned on the lathe, and a quick look around the shop at existing handles will provide all the inspiration needed.

When a shape has been settled upon, begin turning the piece, and shaping the handle. Be careful not to go too deeply, which can cause the dowel to come out of alignment in the chuck. It can also grab a large chunk of wood and potentially throw the piece across the shop.



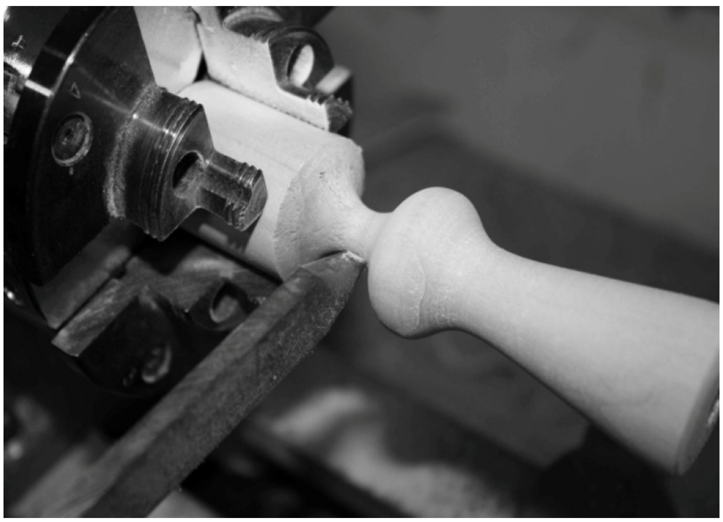
In this case, the handle shape decided upon is sort of a mini pepper grinder shape, which has a knob at the top that can be held on to while turning up the clamping pressure.

Refine the shape while turning the handle on the lathe, and once it is getting close to the final look, begin carving away much of the material above the top, but not so much that it becomes weak.

Knock down any areas that are gouged or sticking out too much, which cannot be sanded out efficiently using the lathe tool. In the picture above there are some ridges that can be seen where the handle flares outward, about half way between the bottom and the top. These will be removed with the carbide lathe tool before sanding.

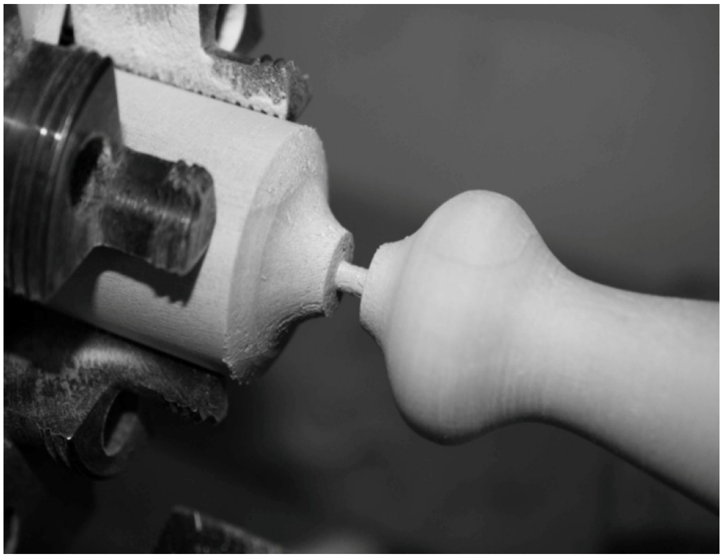
Sand the piece with 150 grit paper until it has smoothed out fairly well, then switch to 220 grit to get it really smooth. This does not need to be absolutely flawless, just smooth enough to be proud of.

The lathe will do the work as the piece is sanded, simply hold the sandpaper against the wood as it rotates, pressing hard enough to sand but not so hard that it risks breaking the piece. Typically the temperature of the sandpaper will dictate the required pressure, as when too much pressure is used the sandpaper heats up very fast.



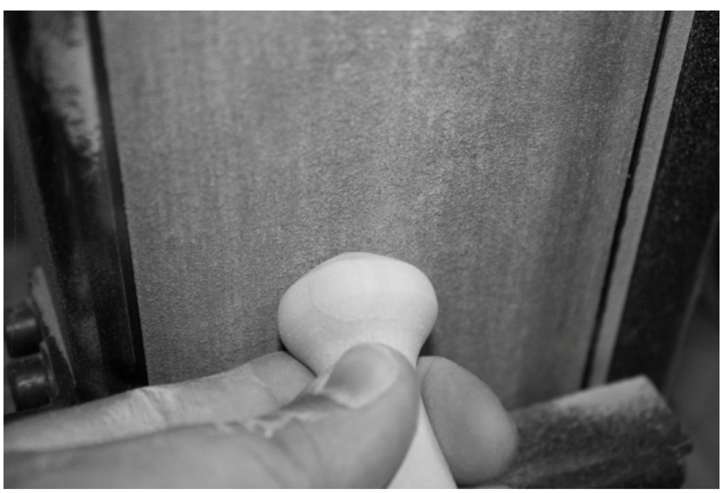
Separate the piece from the lathe using a parting tool. If this tool is not available, the unit can be removed from the lathe and the excess cut free on just about any saw in the shop.

When using the parting tool it is important not to dig too fast, and to make sure the gap being made by the tool is wide enough that the tool does not snag. Make the first cut about half or a quarter of the needed distance to part off the piece, then remove the tool. Move it over half the width of the tool and cut again, widening the space a little bit. Go back to the place where the first cut was made, and continue cutting and widening the slot until it is very close to the center of the wood.



Once only a tiny fraction of wood is holding the piece to the lathe, stop cutting and turn off the lathe. At this point it is safe to break off the piece, which will be easy since the connecting point is so small.

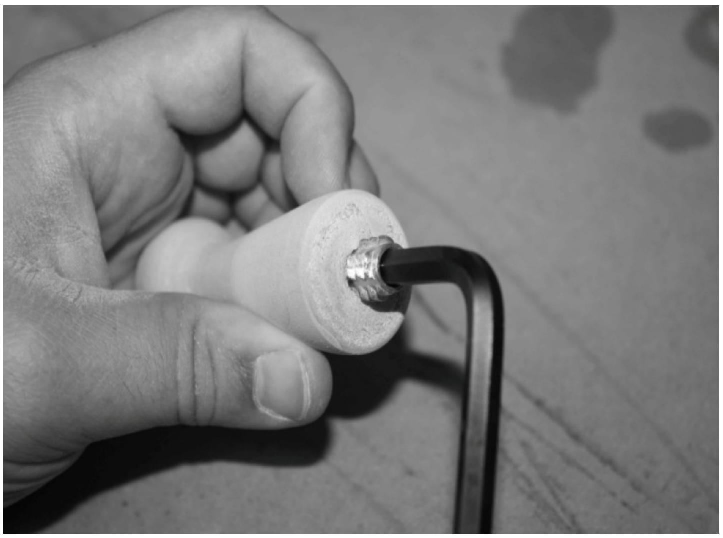
Open up the chuck, and discard the piece inside the jaws, or save it in a scrap bin for later use as something else.



Use the belt sander to refine the shape of the head, and to remove the small piece of wood stuck to the top. This is easiest on a machine sander, however it can just as well be done with a piece of regular sandpaper and a wooden backer.

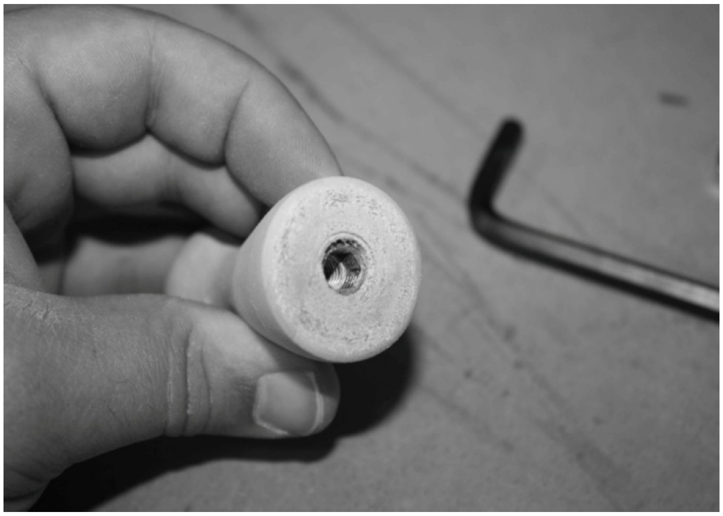
If some extra shaping needs to be done, address it now, and check the piece for any cracks, large gouges, or anything else the sandpaper can fix.

Once the shaping and final checks have been made, it is ready to have the threaded insert installed, which will be how it is attached to the spool clamp.



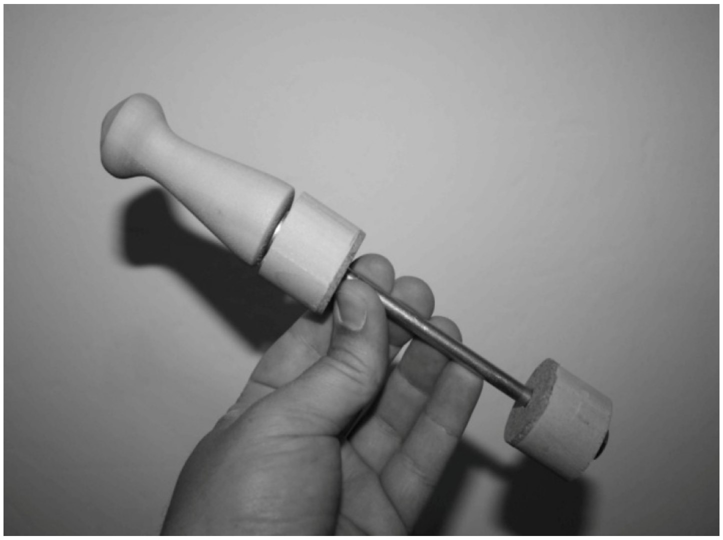
Some threaded inserts are turned in with an allen wrench, and some others with a bolt and a nut which is used as a stopper. However the piece is to be installed, insert it at this stage.

Do not crank it into the hole much further than flush with the face, as this will limit how far the clamp can be opened. Turn the grommet in until the metal is just a tiny fraction below the surface of the wood, maybe 1/16" at the most.



When the threaded insert is fully screwed in, it will sit just below the surface of the wood, and allow a full opening of the clamp. Do not go any further, as it will not let the bolt work properly.

A tiny bit of epoxy can be used with the insert, however this can tend to complicate things later on. The epoxy can get into the space below the insert, hardening in there, and preventing the bolt from being able to screw into this area. Having used these directly in the wood with no problem before, they do not need any extra help staying in place.

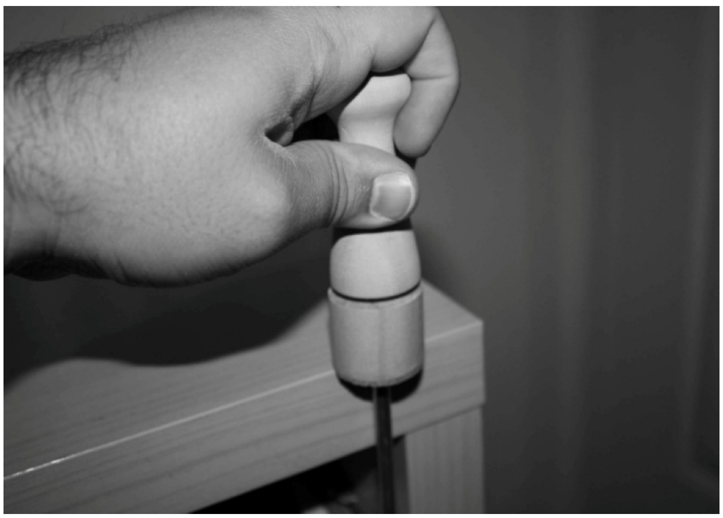


After the handle and the insert are together, it can be put on the spool clamp. Remove the wing nut, and screw on the handle. It should look

like the above picture, and the washer should still be in place between the handle and the top caul.

Check that the handle rotates well, and does not wobble very much. A little wobble is ok, and will not interfere with how the clamp operates, however a ton of wobble will need to be looked at again.

Sometimes the insert can go in funny, which will cause the handle to be slightly out of alignment when turned. Again, this is fine, and will not change how effectively the clamp works at all.



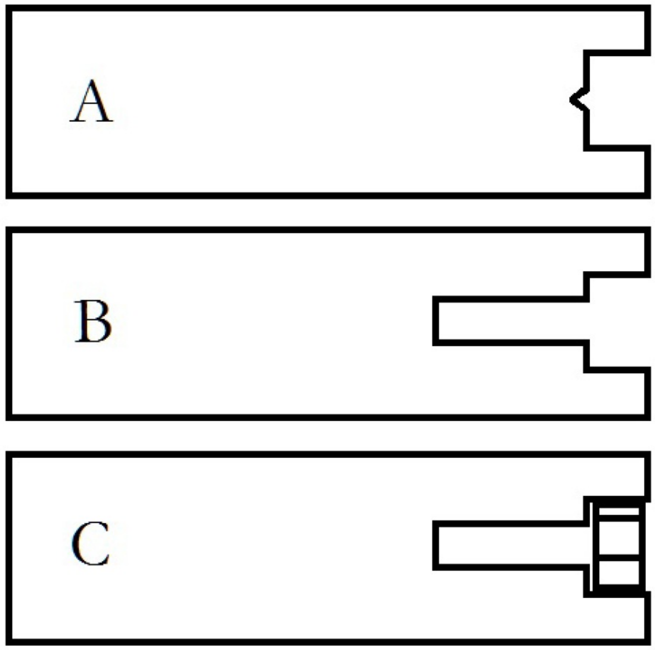
Test out the clamp in a few places, checking to see that the handle works, is easy to turn, and sets the clamping pressure well. This should be far easier to turn than the wing nut, especially when higher pressure is needed.

The nice thing about having handles on the clamps is they can be placed with one hand, while the other hand does something else. Getting them into position is very easy, and taking them off is just as easy.

Handle - Version Two

If a lathe is not available, the handles can still be made in the shop, the only difference is they will not look as fancy. A solid dowel handle, even if the shape of the dowel rod is left unchanged, will do the job of making the spool clamps easier to work with.

The pieces can be cut to length using a saw with a miter gauge to ensure that the faces are flat and perpendicular to the sides. The centers can be marked just like earlier on the cauls, and the centers drilled out for an insert. The insert can be screwed in, and the handle used completely as is. If threaded inserts are hard to come by, or the builder would rather use a regular nut, there is an option for that too.



The handle can be made to work with a standard nut, which eliminates the need to buy inserts, which can get a little expensive especially if 30 or more of these clamps are being made. The nut is recessed into the end of the handle, where it provides the threads just like the insert would.

First, mark the center using a combination square, then drill an opening for the nut as in diagram A above. The hole should be made with a Forstner or brad point bit, in order to leave a nice pin point in the center that the next drill can easily follow. The diameter of the hole will depend on the diameter of the nut, and should be a little smaller. Try a few drills out in a scrap piece, and test fit the nut until a good and tight fit is found.

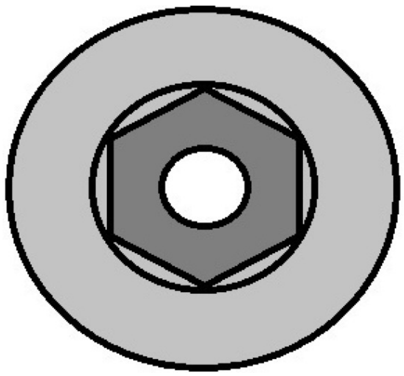
If the nut cannot be pushed into the hole by hand, try screwing it onto the end of a bolt, and hammering the bolt until the nut goes in. Then, simply unscrew the bolt, leaving the nut behind.

Once this drill size is found, drill the first hole, and only go a little deeper than the height of the nut. Drill as straight as possible, using a drill press if available.

After the first hole is drilled, chuck a drill bit that is the same diameter or one size larger than the diameter of the bolts on the spool clamps. Using the center point left behind as a guide, drill inwards an inch or so. The actual depth should be the same as the length of the threads on

the bolt plus a little extra for wiggle room. If the entire bolt is threaded, go in a couple inches, but make sure not to pop out the other end. The piece should now look like diagram B above, where both holes have been drilled, and all the sawdust has been blown out of the recesses.

Insert the nut into the end of the handle, seating it tight against the walls evenly, as in diagram C in the previous column. It can be seated against the bottom of the hole, as long as it does not place the nut too far below the face of the handle.



Looking at the end of the handle, it should look like the diagram above. The nut will be securely fitted into the upper hole, and the center of the nut has another hole going a distance inwards.

To further strengthen the nut against falling out, a little bit of two part epoxy will need to be used around the edges. Mix up some quick setting epoxy, or if none is available a little polyurethane glue can be used as well. Go incredibly sparingly if using the polyurethane glue because it will expand as it dries, and it can get out of hand really quickly.

Drip the epoxy into the tiny spaces between the flat areas on the outside of the nut and the walls of the hole. A tiny bit will do just fine, as it is just to add a little extra reinforcement so the nut does not slip over time.

Once the epoxy has dried, thread the handle onto the spool clamp after removing the wing nut, and the spool clamp is ready to use.

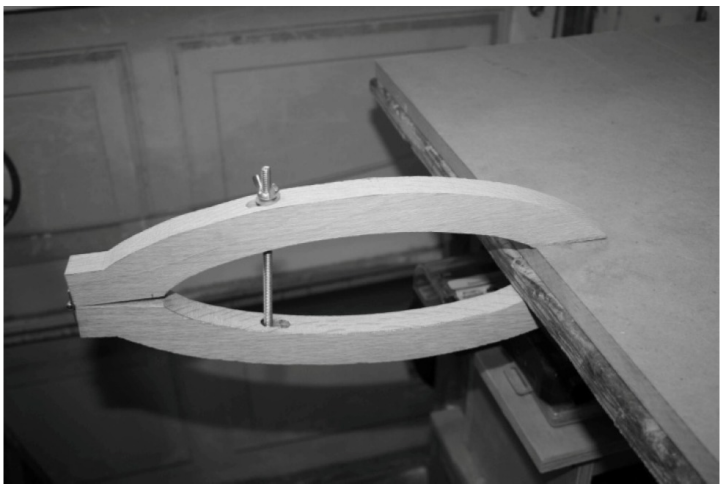
Project Notes:

After all the spool clamps have been made, and the handles made too, they will benefit from a light coating of finish. This will protect the wood from drying out and cracking, as well as make them look better.

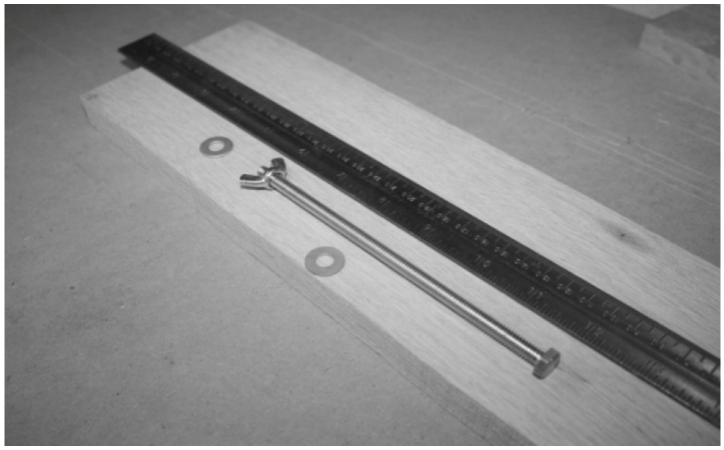
Use either boiled linseed oil, Tru-Oil, or Danish Oil on the wooden parts only, making sure not to get any on the cork faces. Having a piece of hardened finish mar the soft top wood should not be an issue with these types of finishes, however it is not worth taking the chance. Plus, the finish will harden the cork, making it less effective as a clamping pad. Once they have all been finished, let them cure for a couple weeks before using them.

LAPSTRAKE CLAMPS

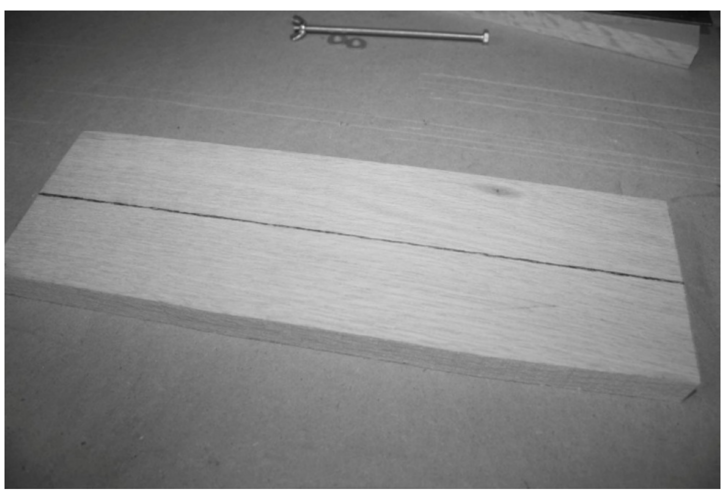
Used primarily by the boat building community, these easy to make clamps are convenient to have in the shop, and useful for many tasks. A dozen or more of these can be made at one time, creating a large array of clamps for the busy shop.



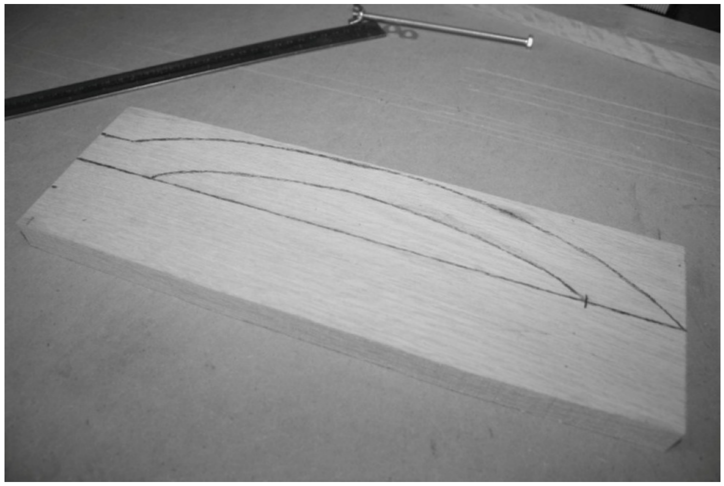
The Lapstrake clamp is simple to make, and provides medium clamping pressure with a very deep throat. They can be made in a number of sizes to suit any need, though the size shown here will fulfill many different tasks. There is a hinge located at the end of the clamp that allows it to open and close in one direction, and the bolt and wing nut are there to adjust the opening and tighten the clamp.



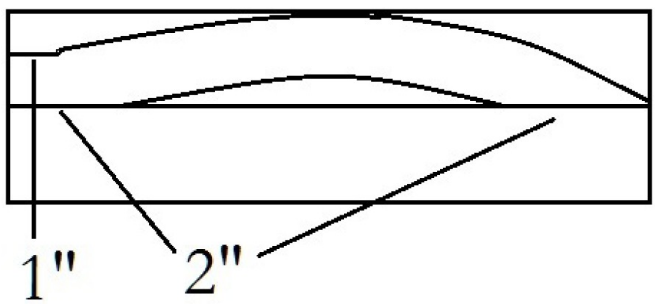
To make the clamp, a hex bolt that is 6" long and 1/4-20 size will be needed, as well as some washers and a wing nut. A small hinge and the accompanying screws are needed for the back side of the clamp as well. Select one that is 3/4" wide or 1" wide for this purpose. The board for the clamp needs to be strong, so use Maple or Oak, and it should be 16" long and 5" wide. A flat sawn piece will be stronger than a quarter sawn piece, because the clamp will be used on edge rather than the face, resulting in a quarter sawn grain direction.



Bisect the board with a solid center line running down the middle, as seen in the picture.



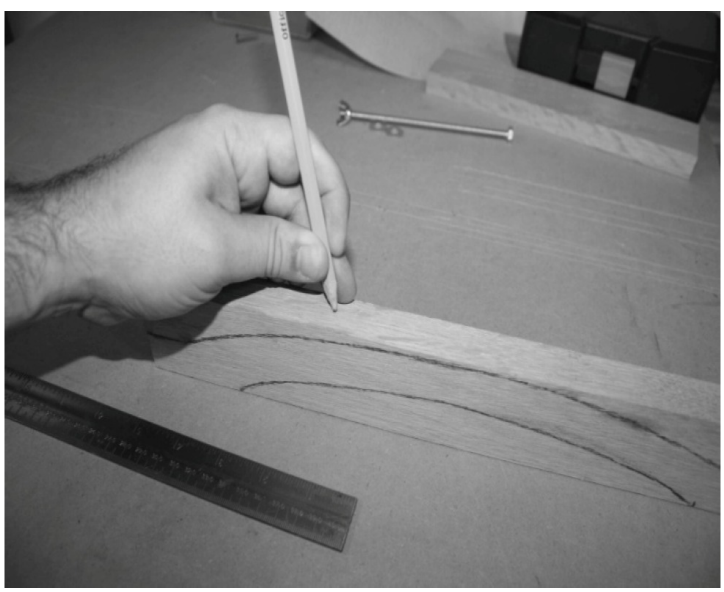
Draw one half of the clamp shape following the diagram below, using the center line as a guide for the overall shape.



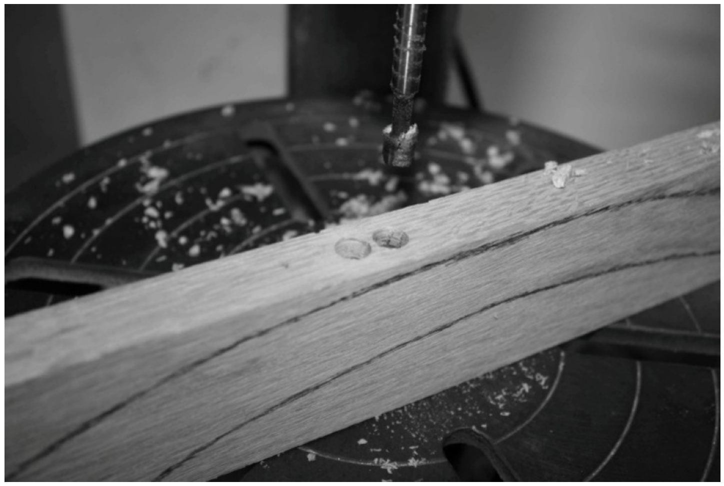
The clamp will start on the left hand side, one inch above the center line, and a line will be drawn one inch inwards, parallel to the center line. Make a mark that is 2" from each end of the center line, and use these marks to fill in the clamp shape. As long as there is at least half an inch of bow in the center, the clamp will perform well. Try and keep the width of the clamp to at least one inch throughout the length of the curve. The bottom shape will be copied by tracing the top shape later on, so only one half needs to be drawn correctly at this point. Several clamps can be made from this one master shape, so take time and draw it nicely.

Saw through the center line only, separating the two halves to make them easier to work on. Do not cut out the clamp shape just yet, as it will be difficult to make the mortise later on.

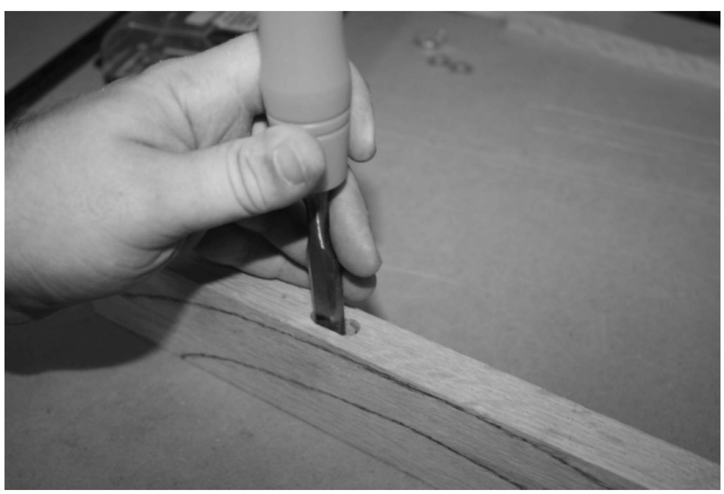
A mortise will be made to allow the jaws the ability to articulate along a wide range of motion, and if the jaws were sawn out at this point, making the mortise on the drill press would be harder than it needs to be. Simply saw through the center line as straightly as possible, and bring both pieces back to the bench for marking.



Make a mark at the center of the top of the clamp, that is 4" from the end. Then make a second mark that is half an inch to the right of the mark as seen in the picture above. These marks will be drilled out on the drill press, leaving a small gap that can be cleared with a chisel.

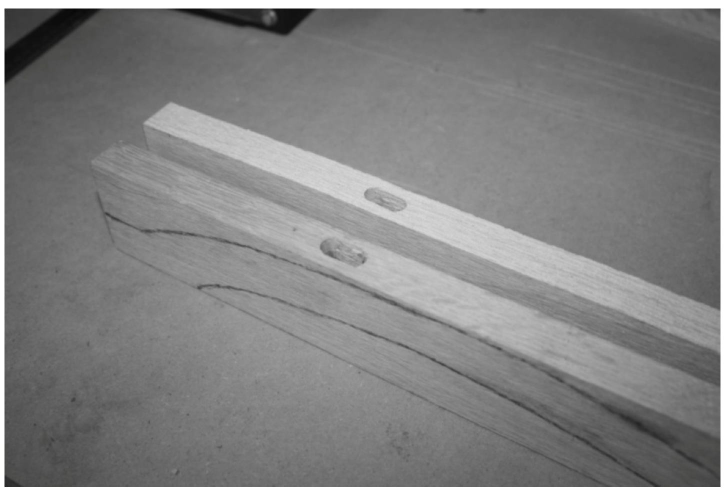


Drill both holes through the piece with a 3/8" Forstner bit, making sure to go deep enough to pass the line indicating the bottom of the clamp.



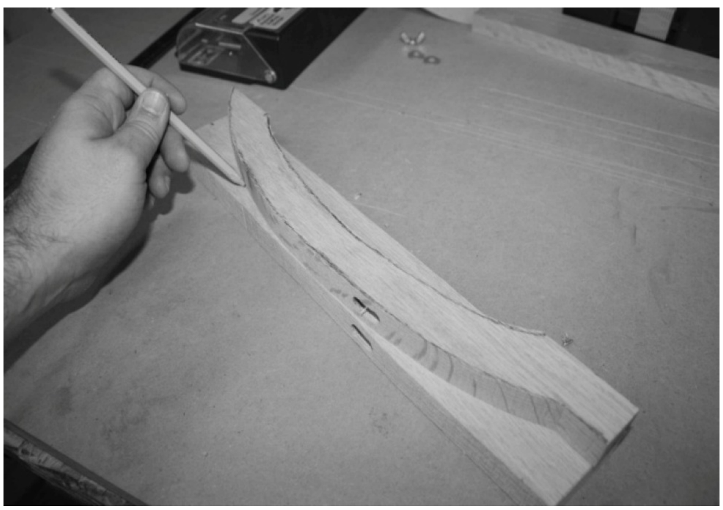
Use a chisel to remove the middle of the hole where the drill has left corners. Be sure to make the wider middles as flat as possible, and leave the ends of the hole rounded.

The mortise should now look like the picture above, with a clean and smooth hole. A small chisel makes easy work of clearing out the waste wood, which will leave a wide opening for the bolt to pass through.

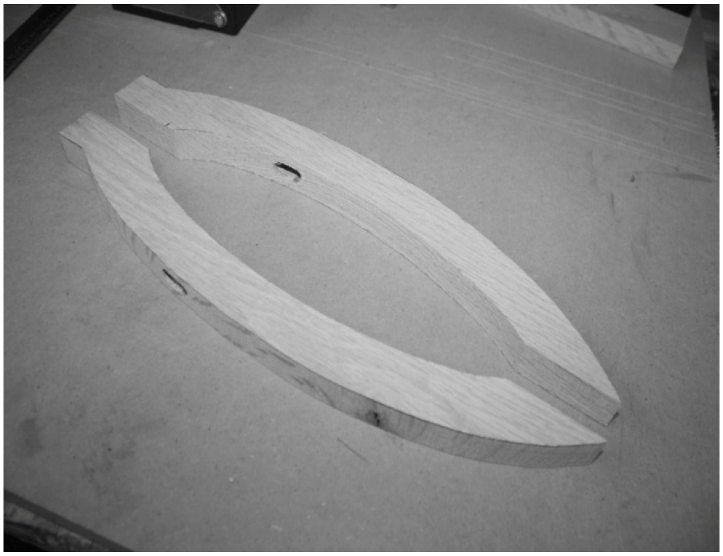


Repeat this procedure on the other half of the clamp, using the first side as a guide for placing the holes. Clean the mortise out well with a chisel.

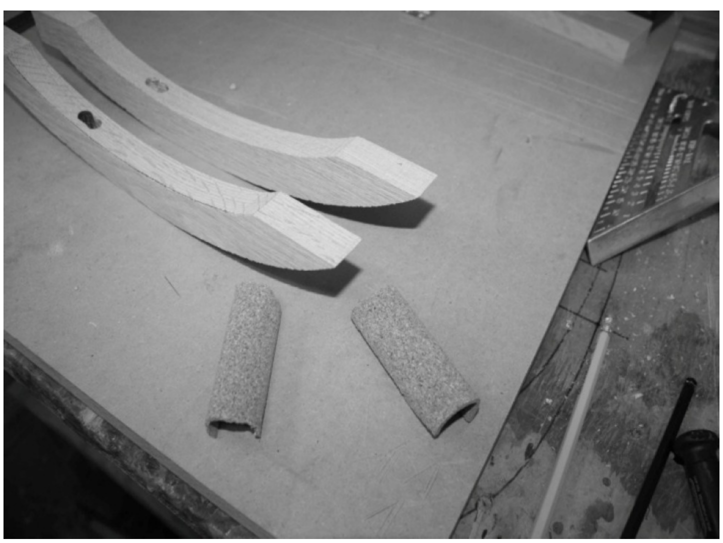
Cut out the shape of the clamp on the band saw or with a jig saw. A coping saw can accomplish this by hand too, if need be.



With the first half of the clamp already sawn out, use it as a guide to trace the lower half of the clamp onto the other piece. Be sure to position the holes in the same place in order to be sure the clamp is being cut out correctly. If making several clamps, this is a good time to make several pieces in the above size, mortise them all, and use the first piece that was cut to shape as a tracing pattern for all of them.



Begin with two pieces of the clamp, an upper and a lower jaw. It does not matter really which two are used, since they are all identical to each other. At this point the faces will need to be covered with a thin layer of cork, which will make them a little softer on the delicate wood used in guitar making.

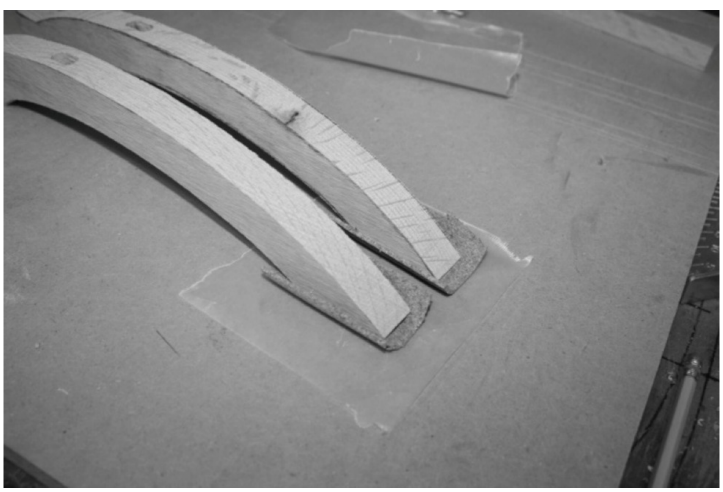


Purchase a roll of thin cork that is around 1/8" thick from an office supply store. This may already be in the shop from any number of other applications, including several of the clamps and sanding blocks

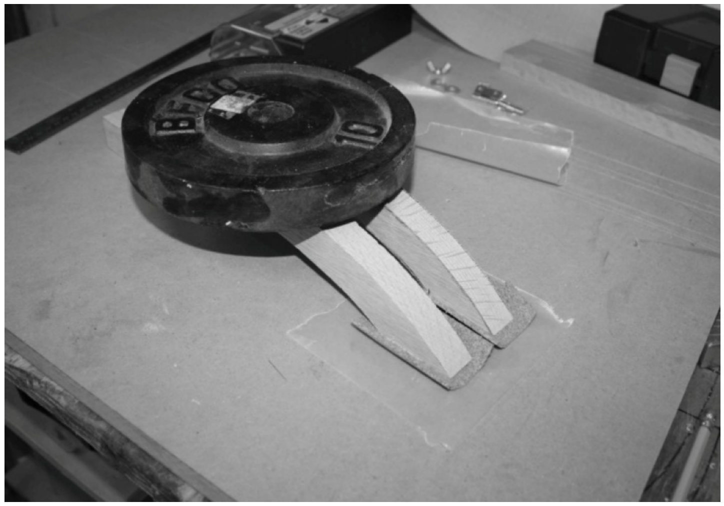
described in this book. Be sure to use the thinner cork available from the store, and not the really thick pieces that are sold in square tiles.

Cut a couple small pieces that are large enough to completely cover the faces of the clamp, which will protect the guitar top especially during clamping. Be sure to cut them a little wider than needed, which will be sanded down once the glue has dried.

Apply a layer of wood glue to the faces of the clamps, being sure to cover all the edges well.



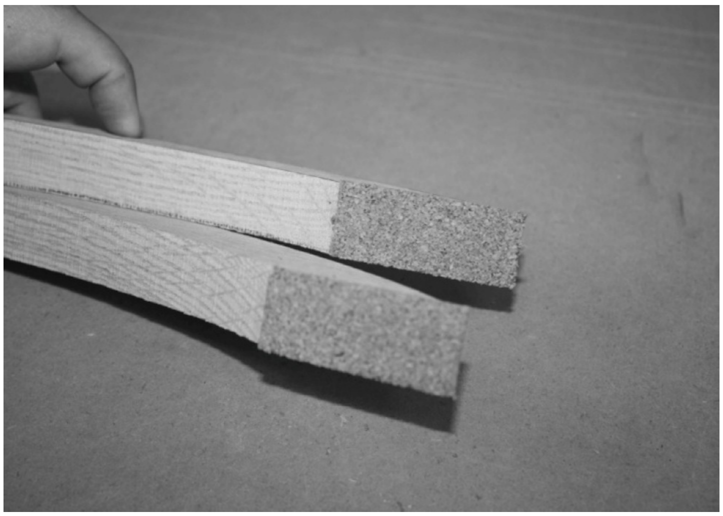
Place a scrap of wax paper on the bench, then lay the clamp ends face down with the cork over the faces. The wax paper will prevent the glue from passing through and sticking to the bench.



Lay a couple gym weights on top of the clamp arms in order to provide the clamping pressure needed to hold the cork in place while the glue dries. A few weights will be plenty, as all they need to do is hold the cork flat against the faces.

Allow the clamps several hours to dry completely before moving on to the next steps. A little extra time when it comes to allowing glue to dry is always a good thing, and will ensure that the cork has had the time it will need to adhere well. Not allowing the glue time to dry may result in the cork faces peeling off during shaping.

Use a small razor knife to trim the edges of the cork once the glue has had time to dry. Get as close to the face as possible while making a clean cut around the edges. If the cork starts to crumble off, the blade may not be sharp enough, or the cork may be very dry. If this happens, make the cut a little farther from the faces, to ensure the cork does not end up being torn off.



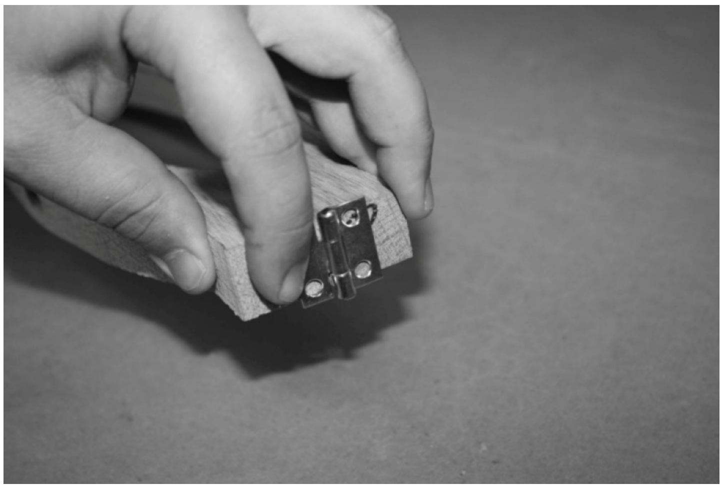
Inspect the faces of the clamps once the bulk of the cork has been removed. Look for any bulges or lumps on the faces of the cork, which would indicate a bad glue joint. If there are lumps, the cork will need to be sanded off and reapplied with better clamping pressure. As long as the cork has been glued in place flat and true, the clamps can be taken to the sander for final trimming.

Lightly touch the ends of the clamp with the cork to the belt sander, and allow it to sand the edges flush to the wood. The sander will remove a ton of cork really fast, so touch the piece for a split second and then look at it before touching it again. Trim all four sides of the cork so they are even with the wood, and then bevel the edges slightly using the sander as well. This can be done by hand if desired, using a piece of sandpaper backed with a wooden block to keep it even.

At this point, the construction of the clamp faces is complete, and the clamp pieces themselves can be sanded smooth. It is important to

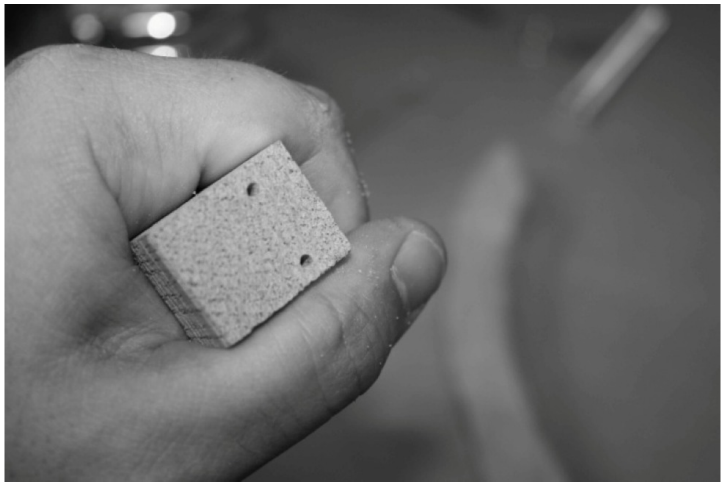
remove any rough edges on the clamp arms, as they can scratch the pieces being clamped accidentally. Use a belt sander or power sander for this step, because it will remove material faster than sanding by hand. If a power sander is not available, a sanding block can be used.

Bevel all the sharp edges around the clamp as well, which will make it more comfortable to hold in the hand. This will also make the clamp look more professional, and cause the owner to treat it better too.



At this point, the hinge can be fitted to the back of the clamp, which will act as a pivot for the clamp arms as they are opened and closed. A small hinge can be used as in this example, though Lapstrake clamps have been hinged differently in the past.

A small piece of leather is typically tacked to the back side of the clamp, which will need to be very thick and strong to support the clamp while pressure is applied at the faces. A thick piece of nylon webbing can also be used in place of the leather, providing the same type of lever action. For this example, and since at the time this clamp was invented hinges were not available, a small metal hinge will be used instead.

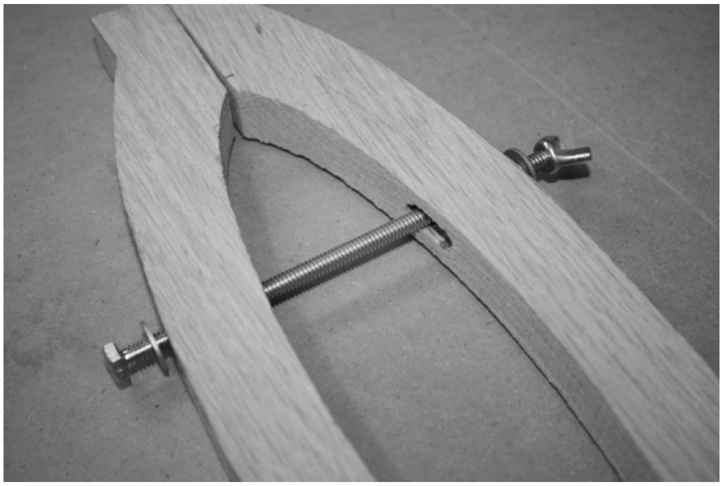


Place the hinge over the end of the clamp as seen in the previous picture at the top of the column, and mark the locations of the holes. As long as they are around 1/4" inside the edges, they will be plenty strong. Use a very small drill bit to pilot the holes for the screws, which will prevent them from splitting the wood as they are turned in.

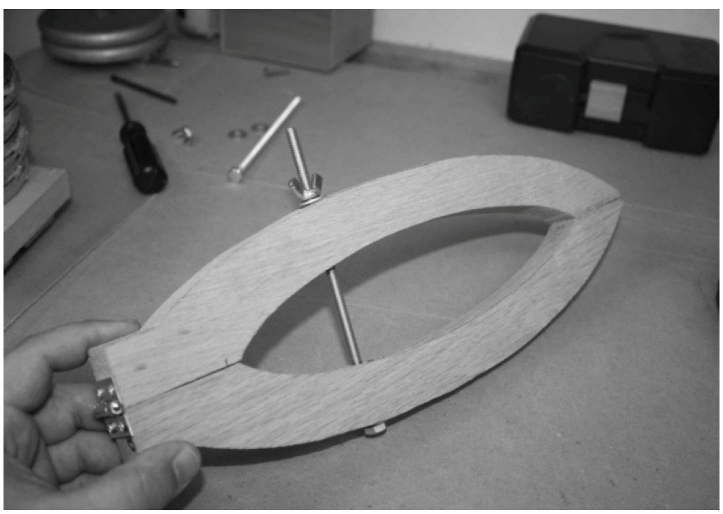
Select a drill size that is the same width as the screw body inside the threads. This way, the threads will be the only part of the screw that digs into the wood when it is inserted. A small pilot hole can be made on both sides of the clamp at this point, getting the arms ready for the hinge to be screwed in place.

Screw the hinge to the end of the clamp using a screwdriver instead of a drill, which can force the screws in too far, destroying the grip

of the threads.

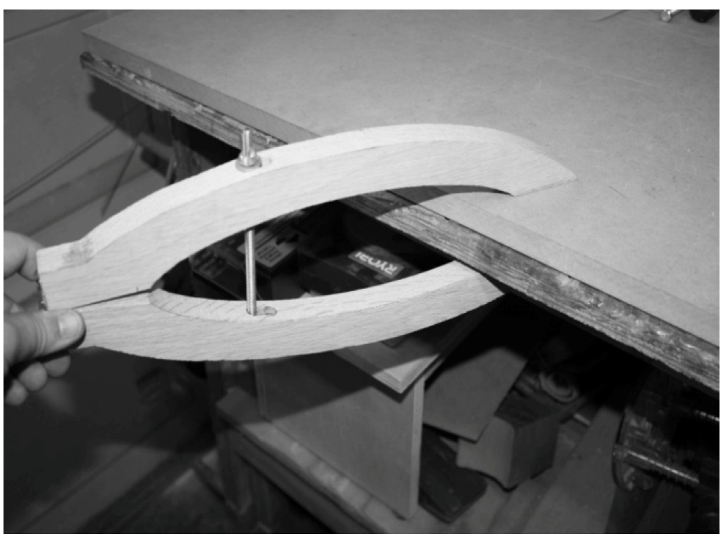


Next, place a washer over the end of the 6" bolt, and send it through the mortises. Place a washer over the top, and finish it with a wing nut over that.



At this point, the construction is completed, and the clamp is now ready to use. Tighten down the wing nut all the way to make sure the bolt is free of burrs, and test the articulation of the jaws by loosening the wing nut all the way.

To use the clamp, the wing nut is loosened to allow the jaws to open as wide as needed to get around the item to be clamped. Position the clamp with the faces over and under the item, and press the clamp arms together. Tighten the wing nut until the faces are exerting enough pressure to hold the piece in place, and it will hold tightly until removed.



A light coating of Tru-Oil or boiled linseed oil can be applied over the clamp arms to protect them from drying out and cracking. The finish will also give a nicer look to the piece, and encourage it to be treated well. A good looking and well made tool seems to be treated better than a rough looking and poorly made tool. Take the time to make these clamps

well and finish them well. They will then become an integral part of the guitar making process, and also become a treasured possession.

These clamps will be the most useful when clamping the braces to the soundboard or the back plate, as they have a long reach. Deep throated clamps are very expensive to buy in the stores, and they are really no better than those made in the shop. A set of a dozen or more of these clamps as well as some cam clamps described later in the book, will be a great start to having the tools needed to make excellent guitars.

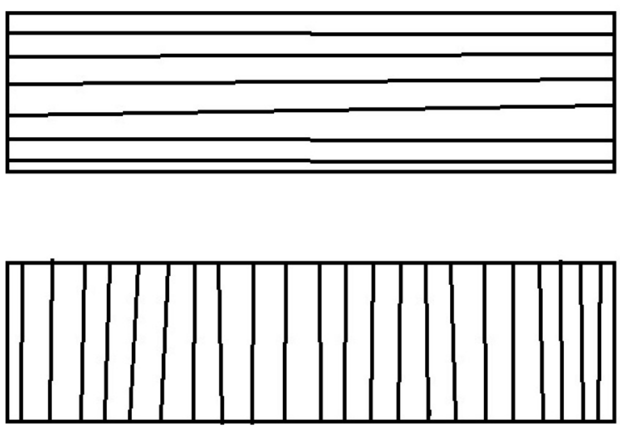
CAM CLAMPS

Guitar making requires lots of clamps in many different sizes. This can get expensive very quickly, because good clamps are not cheap. Also, clamps with a very deep reach are required in many cases, which are hard to find. The soundboard alone can take more than twenty clamps to hold down the braces during gluing, many of these being deep throated clamps. Buying all of these would cost a small fortune, so thankfully they are pretty easy to make.

Cam clamps retail for far more than they should, however making them in the shop will get the cost down close to 1/10 the price. Less if the wood being used was scrap, or if some of the required items are already in the shop. While making these clamps, it is a good idea to make many of them at once. It is not much more time consuming to make twenty of these as it is to make five, because it will take longer to set up the tools than it will to make the cuts. The actual cutting and shaping of the wood is minimal, so running several pieces of wood through the same operation is very easy.

Having a few different sizes works out very well, because deeper clamps can get into harder to reach areas on the guitar. The size being shown here has a 9" set of jaws, but having them in 6", 9", and 11" sizes will be useful too. Again, while the tools are set up, make as many clamps as there is wood for. There can never be too many clamps in the shop.

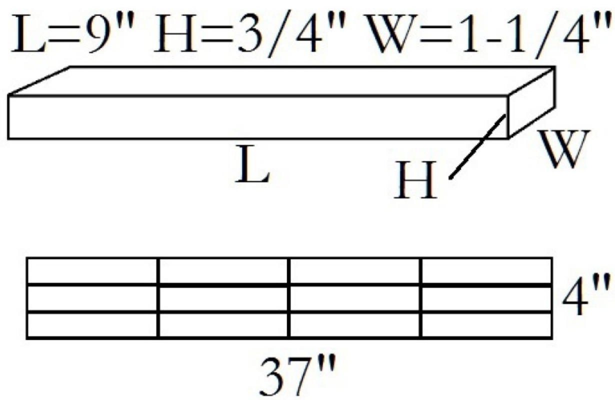
A cam clamp is two wooden jaws held together by a metal spine. The upper jaw is cut most of the way through, allowing the lower part to flex. A cam lever is used to flex the upper jaw, which exerts pressure on the item being clamped. The further the cam lever is rotated, the stronger the clamping force. To reverse this, the cam lever is rotated back to the original position, releasing the pressure, allowing it to be removed.



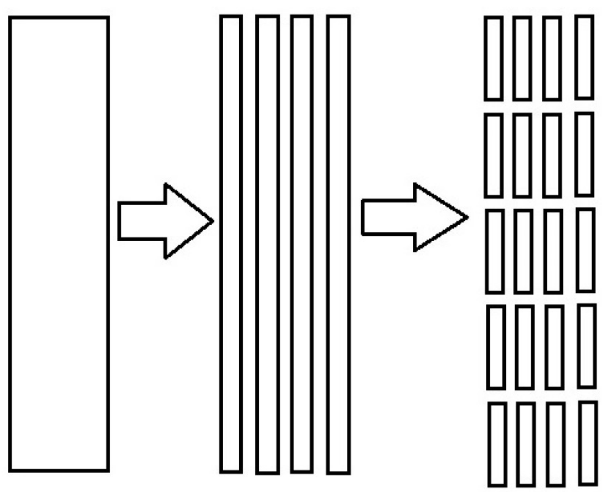
The best wood for these clamps flat sawn Maple, though most hardwoods that are resistant to cracking will work as well. Mahogany makes a good clamp, and so does Cherry. The reason the wood must be flat sawn to the faces is because the clamp arms are going to be used on their edges. This means the resulting grain orientation will be quarter sawn, making it harder for the clamps to split while being used.

The above diagram shows the difference between flat sawn wood on the top and quarter sawn wood on the bottom. Looking at the piece

of wood from the end of the board, the growth rings are checked for which way they run. Left to right means flat sawn, and vertical means quarter sawn. Do not use anything with diagonal growth rings because it may cause the clamp to twist while being used.



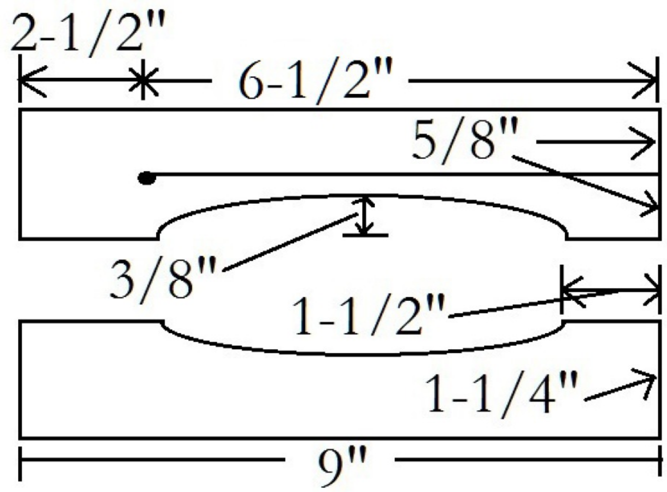
Once the wood has been selected, it is time to start cutting out the arms. These are all 9" x 1-1/4" x 3/4". Look for the best way to cut as many of these out of a single piece of wood as possible. The table saw is the best place to make these cuts, as it tends to leave a fairly flat surface behind. The band saw will work, however a stop must be set up to make the cuts smoother.



The above diagram shows a good method for cutting as many pieces out as possible from one solid board. First the piece is ripped into 1-

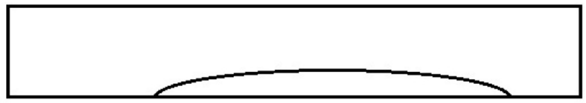
1/4" wide sticks using the saw, and each stick is set aside. After the main piece has been ripped into as many long sticks as possible, it is then cross cut into 9" long pieces. This can be done on the table saw with a miter gauge and stop, or on the chop saw using a stop.

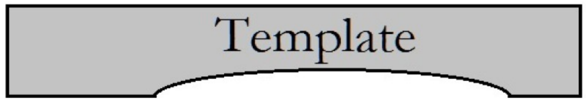
A piece of wood that is 8-1/2" wide, 65" long and 4/4 thickness will yield enough arms to make 21 clamps that are 9". Longer bars will make less clamps, and shorter bars will make more. However, the 9" is the most versatile of all the sizes, which is why it is demonstrated here.



Once all the arms have been cut to rough size, the next phase of shaping can begin. The only difference between the top and the bottom pieces is the horizontal cut going through the center. The sizes of everything else are the same, and the pieces should have the same profile.

Cut the curved swoop out of the center of all the arms first using a band saw or jig saw, since this is the same for every piece. Measure 1-1/4" from one end and make a mark, then measure 2-1/2" from the other end and make a mark. The maximum depth of the curve is 3/8", and drawing it in by hand is the easiest way. If several are going to be built, use the first piece cut to mark all the others. This will save lots of time marking each one by hand.





The above diagram shows the first arm cut out being used as a template. Lay it on top of the next arm and mark the curve with a pencil. Align the two pieces well, and lightly mark the curve on each arm using the same template.

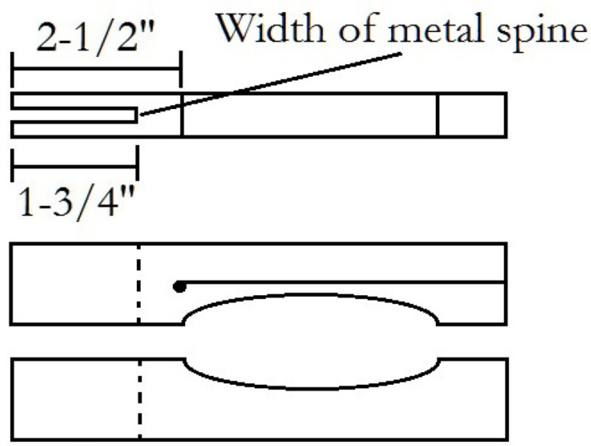
Now that they are all marked, run them through the band saw to remove the waste. The saw cut can be smoothed out after band sawing by using a curved sanding block or belt sander. This is not necessary, however the resulting clamps will look nicer in the end.

The next step is to decide which half will be the top arms and which the bottoms. The only thing to look for are knots or cracks in the wood when making that decision. The defective pieces go on the bottom where there is less likely a chance they will become problems.

The half of the arms to be upper arms need to have their holes drilled and their horizontal saw cuts made. The drill holes are first, and the reason for that is they help the lever open better at the joint, and discourage splitting at that location.

Measure 2-1/2" in from the left side, and 5/8" down from the top. Make a mark with a pencil, and do that for all the top arms. Chuck a 1/8" drill bit in the drill press or hand drill, and drill completely through the piece. Do this on all upper arms.

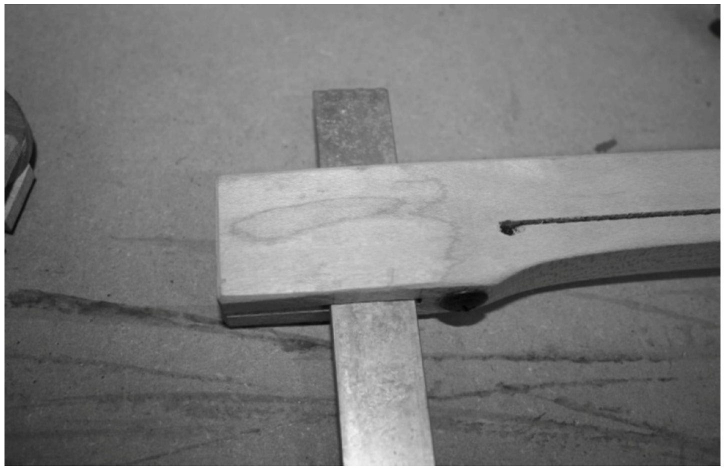
The horizontal cut is next, which is what allows the top to flex and clamp. The saw cut needs to intersect the hole on the top edge, which means that the sawing has to happen on one side of the line rather than directly on it. Whether using a band saw or a jig saw, mark a line at 5/8" and saw on the left side of it to make it intersect the top of the drill hole. If a stop is being used on the band saw, set it up so the resulting cut is a little shallower than 5/8", and it should intersect the top of the drill hole just fine.



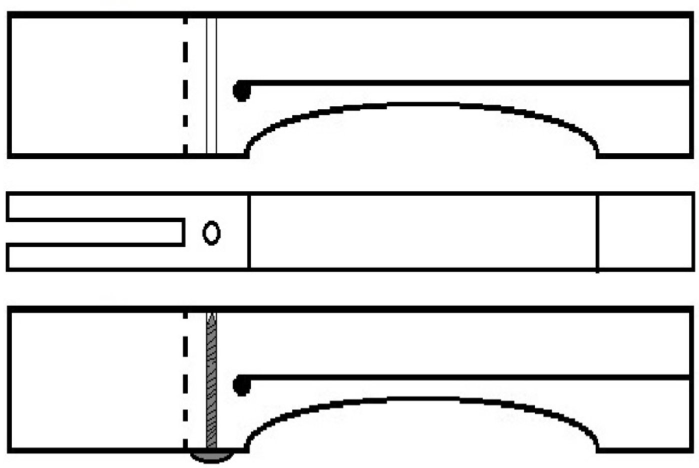
The part of the clamp that joins the two arms together is a metal bar called a spine. These are simply flat metal bars that are 1" to 1-1/4" wide, about 1/8" thick, and come in 36" or 48" lengths at the hardware store, usually near the threaded rods.

Select a piece of plain steel, zinc coated steel or aluminum, all of which will work. If many clamps are being made, there are usually longer bars available which will be less expensive for the amount being purchased. Each clamp will need a 9" bar, meaning a 36" bar can make about 4 clamps.

The next step is to cut a slot in the back of each clamp arm that will allow the metal spine to pass through it. Measure 1-3/4" from the spine end on all the arms and make a line across the top, like in the upper diagram. This is the depth that will need to be cut for the spine. The width is dependent on what kind of bar stock is purchased. Measure the width of the bar, and cut the slot just a tiny bit wider so the bar can pass through smoothly but not loosely.



The above picture shows what the slot looks like with the bar in it.

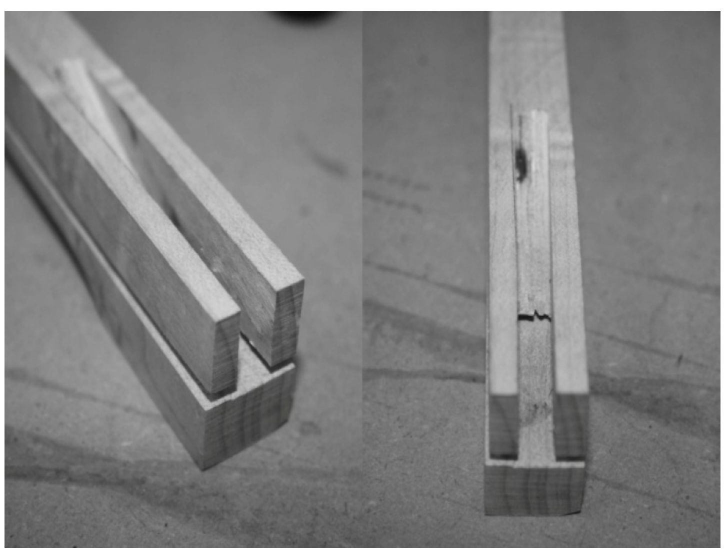


The next step is to drill the hole for the support screw that is needed. The support screw serves as a backup to hold the flexing end of the wood together to help prevent splitting. This hole needs to be centered on the arm, and in the middle of the spine notch and drill hole on the side.

The above diagram shows where the placement of the hole is in relation to the notch and the hole drilled earlier on the side. The size of the hole depends on the size of screw being used, though any wood screw that is 1-1/4" long will work. Drill the pilot hole just a little smaller than the threads on the wood screw, and it will go in without splitting.

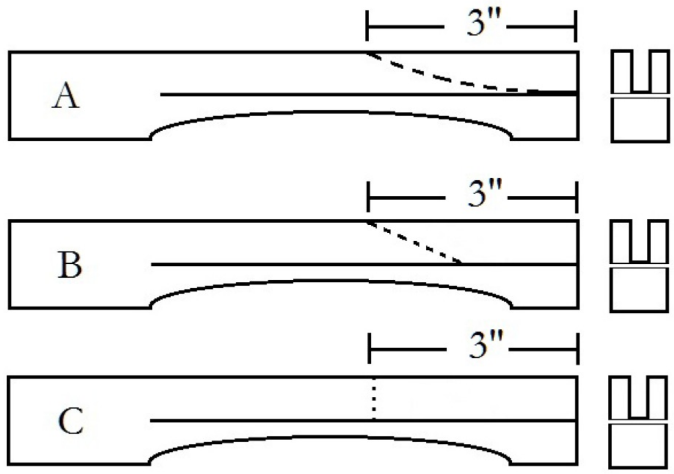
After the pilots have been drilled, screw in the wood screws snugly. If the tips stick out of the top end, they can be ground off with a Dremel or lightly hammered until the tip is blunt and slightly below the surface of the wood.

The screw in the above diagram is a little far away from the spine, and a bit off center but this is fine. The function of the screw is to keep the wood from cracking, and as long as it is in the general area, it will do that.



The next step is to remove some material from the top arm where the cam lever will go. This can be done with a number of tools

including by hand with a saw and chisel. However, the work will go much faster with a router, or table saw.

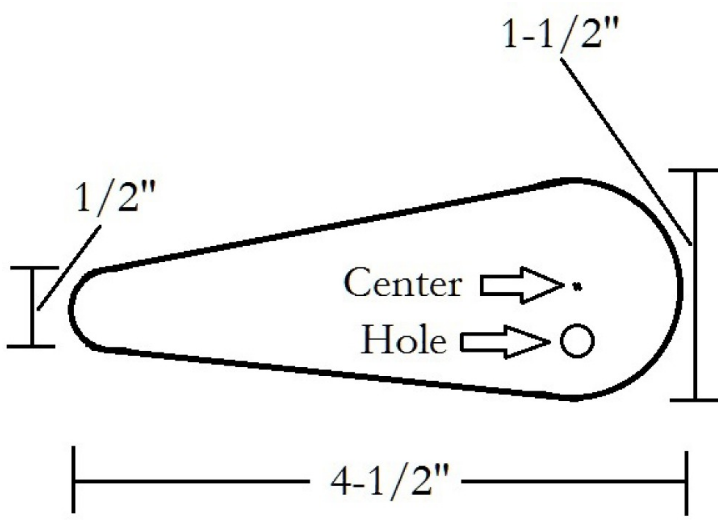


The above diagram shows the three upper arm profiles that are possible with different tools. Profile A is when the slot is cut on a table saw. The blade leaves a circular cut behind, which the cam lever can lay in. Profile B shows what it would look like if cut with a hand saw, and the remainder chiseled out. Lastly, profile C is what it would look like if a router table was used with a straight bit.

The width of the slot is determined by the thickness of the piece of wood being used for the cam levers. This example uses 1/4" thick wood for the cam levers, so the slot is just slightly larger than 1/4".

Another reason for a 1/4" cam is that there is less wood to be removed from the top arm of the clamp. The width of the arm is only 3/4", so when 1/4" is removed for the cam, only 2/3 of the wood will remain behind. There needs to be enough wood left to hold up while the clamp is applying pressure.

Making the cut by hand is not as hard as it sounds. First, put the piece in a vise to hold it securely while being cut. Next, a few pieces of thin wood are inserted into the horizontal cut to move the thin flexible jaw out of the way. The hand saw is then used to make two cuts that are as deep as they can go while staying within the 3" mark on the top and not going through the lower part at all. The arm is removed from the vise, and a small chisel used to remove the waste wood. Repeat this procedure on all the top arms.



Next comes making the cam levers that will go on each clamp. Following the diagram, make one cam lever from a piece of wood that is

1/4" thick, that can be used as a template for others. After creating the master cam, check that it fits nicely into the slots on the upper arms.

Trace the cam onto the piece of wood being used to cut the rest from, and try to squeeze as many as possible on there. Once they have all been laid out, cut them free with a band saw or jig saw. Sand the edges a little bit so they are not jagged, paying special attention to the area around the larger end. This is important because it will encourage smooth operation of the cam while clamping.

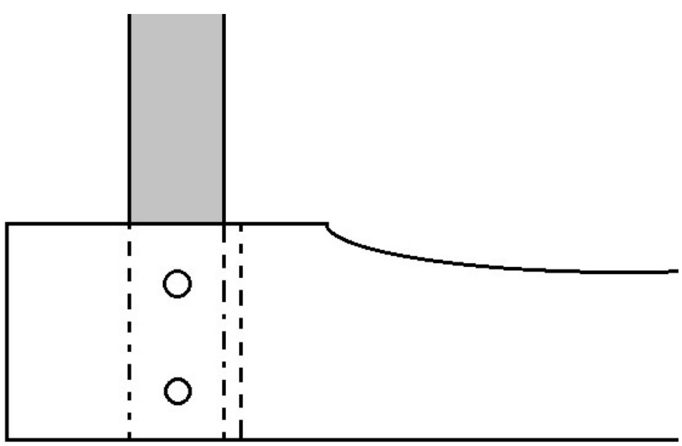
Gather up all the newly made cam levers and set them aside. Do not drill the holes in them yet, because the size and shape of the slot cut into the upper arm will determine where the hole goes. It is much easier to line everything up together and drill the hole through both pieces.

The next few steps will involve assembling everything with pins, which can be bought specially for the purpose, however nails will do the same thing.

The nails need to have large heads, measure one inch long, and be fairly thick like the one seen in the picture. These make excellent pins once the ends are cut and peened over. Look for a box of nails that are a little bigger than 1/8" thick, and five nails will be required for each clamp. A small box will do several clamps, and should last a long time.

Cut the metal spine material to 9" lengths with a hack saw, making clean and straight cuts. Sand any sharp edges with sandpaper so they do not accidentally cut anyone. The next step will require the spines as well as the lower arms of the clamps.

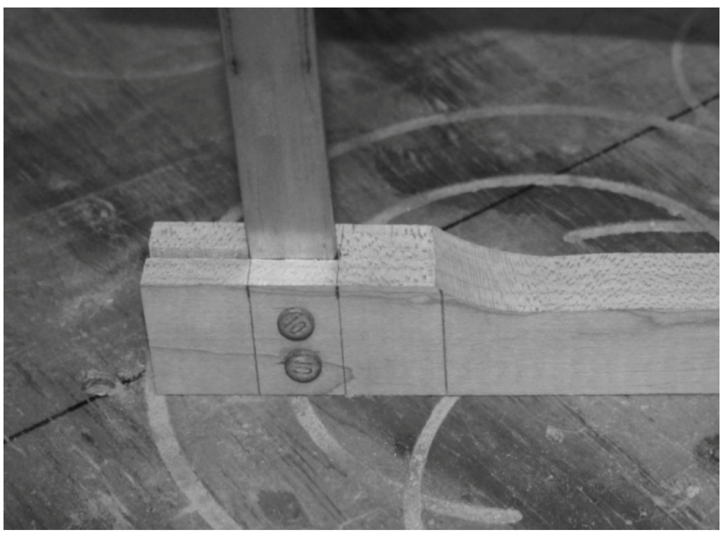
The first step in assembly is to attach the spine to the lower arm with two pins. These pins will keep the lower arm at a 90 degree angle to the spine, and keep it from coming off under clamping pressure.



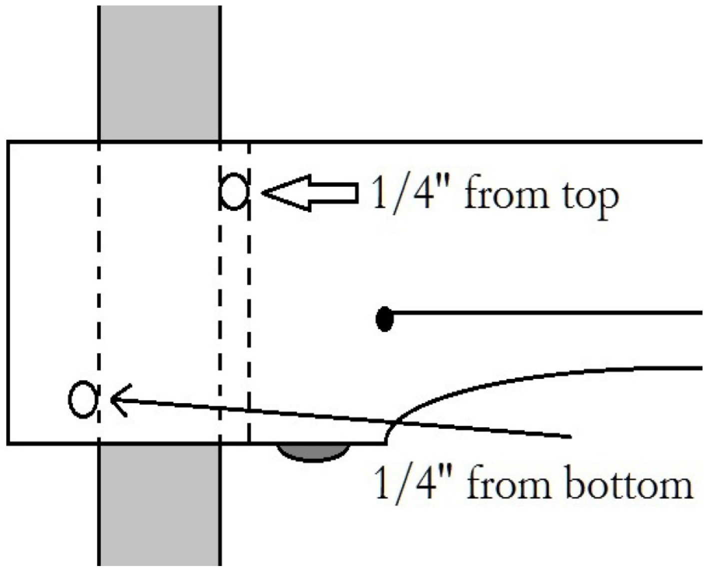
Insert the spine into the lower end of the clamp as seen in the diagram. There is a little space between the inside edge of the bar and the end of the cut that was made into the left side of the wood. This space should be the same as the thickness of one nail, which is for alignment purposes. The top arm will have this same small off-set, which means in order to line up, the bottom arm will need to have it too.

Drill two holes through the lower arm like in the diagram, and then insert the spine. Drill again using the first holes as a guide, remembering to keep the spine at 90 degrees to the lower arm. The drill bit being used needs to be as close to the size of the nails as possible, even if some light hammering is needed to send the nails through. The pin must not wiggle inside the hole at all.

Once the holes are drilled into the piece, insert two nails to hold everything in position.



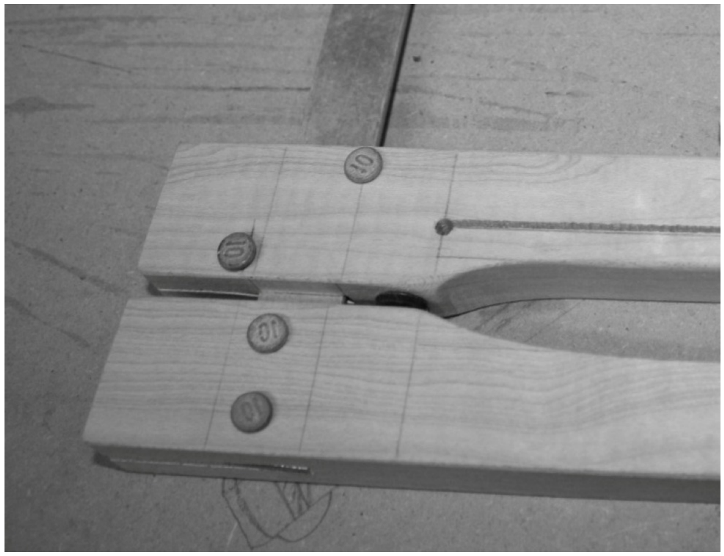
The picture shows the two pins that lock the spine bar into place. The heads of the nails are set all the way against the wood, and the points stick out on the other side. When assembling everything, keep the nails all going in the same direction because it will be easier to saw them all off and peen them over.



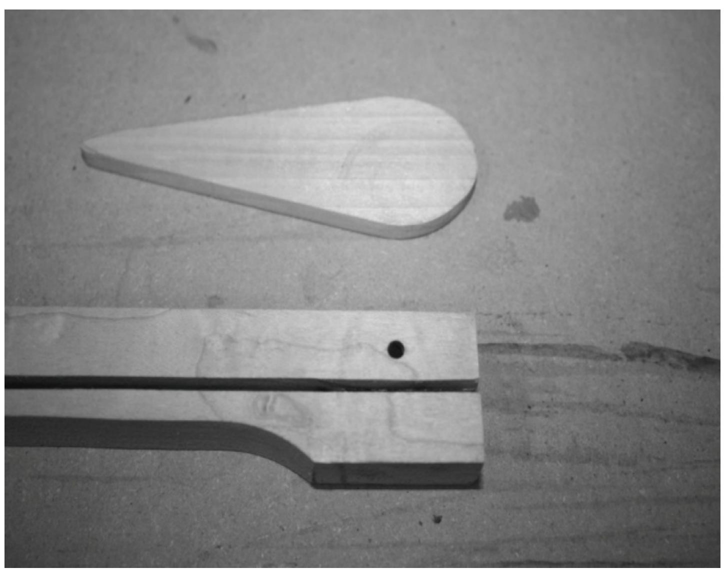
The upper arm is the next part of assembly, and it needs to have a couple holes drilled into it before hand. These holes will take a couple pins that will act as a break, holding the upper arm in place while the clamp is working.

It is very important that the pins go on in the exact orientation as in the diagram. The pin on the right must be higher than the pin on the left, otherwise the locking action of the upper arm will not function at all. Also, the location of the pins is important so there is enough wood to push against without fear of wood splitting under the pressure.

Mark a couple lines for the location of the spine, with the inside line being one nail width from the inside of the wood cutout. The first drill hole goes through as seen in the diagram, 1/4" from the top and near the inside wall on the right. The other hole goes 1/4" from the bottom of the arm and is just far enough away that the spine can slide between them.



The clamp should now look like the picture above, with four of the nails in place. The top arm should be able to slide up and down the spine when moved by the end with the nails, and the bottom should be solidly locked in place.

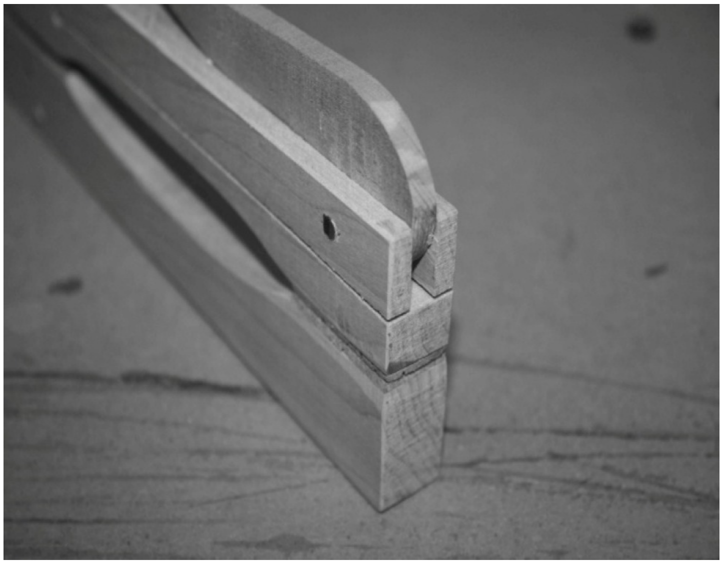


Now it is time to start attaching the cam to the upper arm. First, drill a hole on the upper arm that is 3/4" away from the right end, and in the middle of the upper part of the arm. Drill all the upper arms like this.

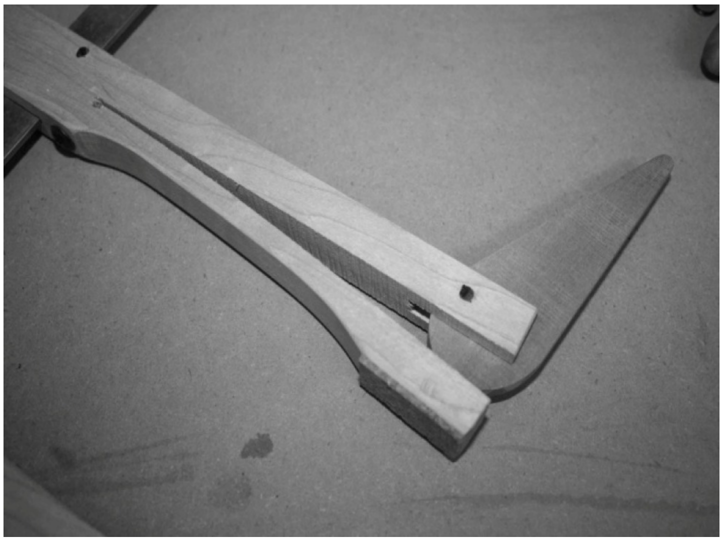
Place the cam lever into the slot and position it for drilling. The diagram from two pages ago that shows the detail on how to construct the

cam lever will show where the hole should be placed. Mark the hole location on the cam while it is in the upper arm.

Remove the cam lever and drill the hole with the same drill bit that has been used for all the other pins being inserted. Place the cam back into the slot, and insert the pin.

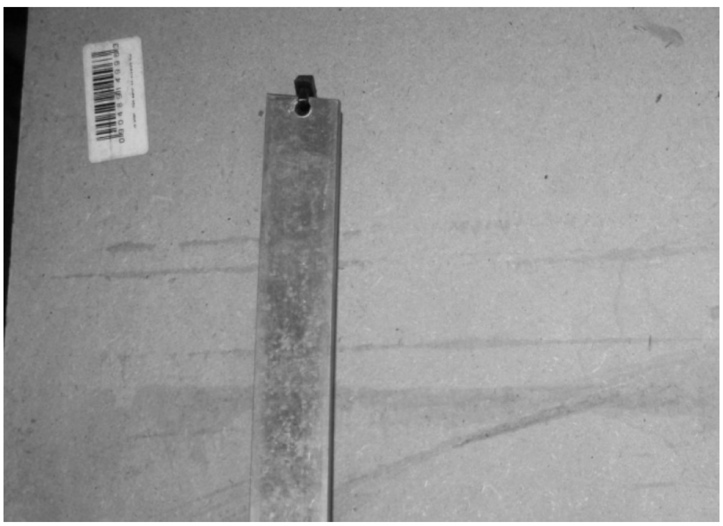


With the cam lever in the down position as seen in the image, the lower clamping portion of the upper arm should not be flexed at all. If it is, the hole was drilled too high on the cam lever, and will need to be drilled again.



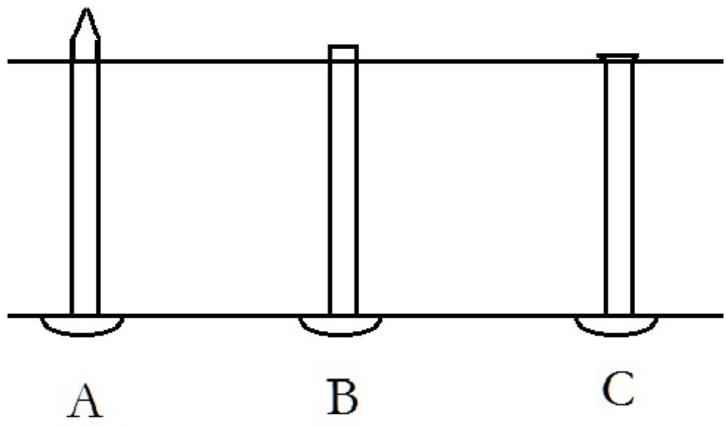
When the cam arm is in the up position, the lower clamping arm should bend downwards and stay in that position. If the lower arm does not bend very far, the hole in the cam lever was drilled too far to the right when looked at the diagram three pages back.

Start with a new cam lever and try lining it up and drilling it again. Once one lever is correct, it can be used to locate the drill hole on all the other levers, which will make fitting the rest of them very easy. Drill the remaining cam levers once this first clamp works well, and install them with their pins.



With the spine as it is right now, the upper arm can slide off the top when the clamp is opened all the way. Drill a small hole 1/4" from the top with the same drill bit, and attach a small zip tie through the opening. Pull it completely closed, and cut off the tail with a scissors. This small piece of plastic will keep the upper arm from sliding off when opening the clamp all the way.

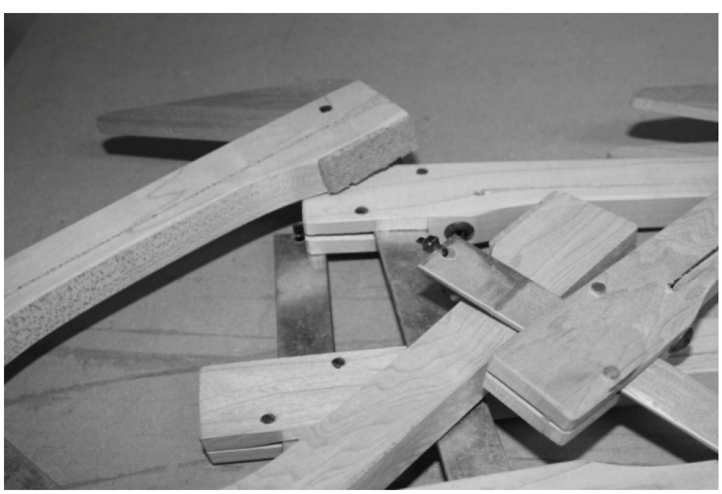
A small machine screw and nut can also work, and will require several short screws and nuts. The effect is the same, however the work involved is far more with the machine screws than the zip ties.



The last thing that needs to be done to the pins is they need to be cut down and peened over so they stay in place. This locks everything together, and requires no further maintenance.

The nails should all look like nail A in the above diagram, sticking out a little past the wood. The first step is to cut them down with a hack saw so that about 1/16" sticks out past the wood. The nails will then all look like nail B. Finally the nails are hammered with a rounded face hammer until they expand outwards slightly at the top. The expansion prevents the nails from coming back through the holes.

Set the head of the nail against a hard surface that does not give, and begin hammering the other side. The nail end should widen slightly, and end up larger than the hole drilled. Repeat this for all the rest of the clamps.



The last thing to do is glue some thin cork on to the jaws of the clamps so they do not damage the surfaces of the guitar. Glue small rectangles of cork in place, and trim the edges when dry.

Taken care of, these clamps will last many years if not a lifetime. Make several of them in different sizes, because there can never be enough clamps in a workshop.

USING TEMPLATES

There are several areas in guitar making that can benefit from using templates. The soundboard bracing, fretboard taper, bridge profile, and headstock can all be made more accurate and repeatable with a good template. They do take a little time to build, however they greatly decrease the time it takes to measure and layout the design on each piece.

Templates can be made from any scrap wood laying around the shop, though thin pieces of wood tend to do the best. A 2' x 4' sheet of MDF that is 1/8" or 1/4" thick can make dozens of different templates for any part of the project.

The above picture shows a selection of templates for several different aspects of guitar making and wood working. There are a few headstock templates, which make marking out the headstock profile a breeze. A violin side profile, fretboard taper templates, and even a couple small tobacco pipe templates.

These all decrease the time it takes to hand draw and measure the layout on each piece, which decreases the time it takes to make an instrument. Also, each headstock made from the same template will be the same size, and shape, giving uniformity to the build.

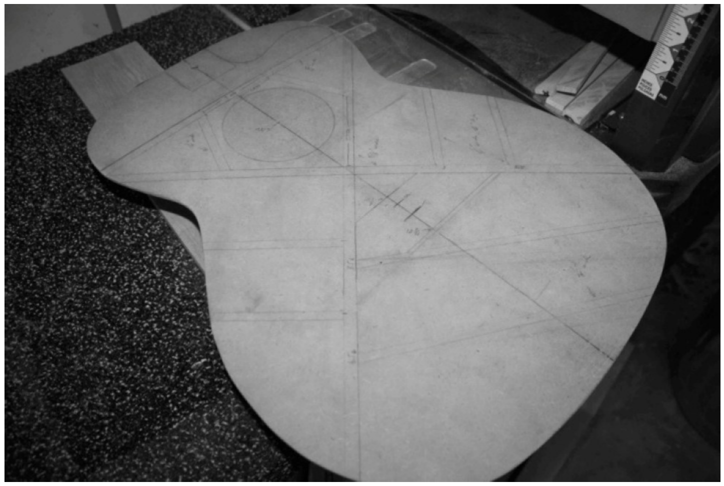
The soundboard is one area that really benefits from having a template drawn up that accurately details where the braces should be. A good soundboard template is an exact reproduction of the top, with the locations for the braces shown with detailed measurements. It also has the exact profile of the sides, so it can be used to make a guitar body mold, or any time an accurate outline of the body shape is needed.

In order to start making the template, a scale drawing of the guitar top is needed. This can be from a paper diagram that was found in a book, can be drawn free hand, or can be traced from an existing guitar. A photograph of a guitar can also be taken to a copy shop and blown up on their machines until the image is life size. The easiest way to do this is to get a high resolution picture online and bring it in. Once the picture is big enough that the lower bout measures the same as the real guitar, the size is correct. Get a couple copies because they will be drawn on.

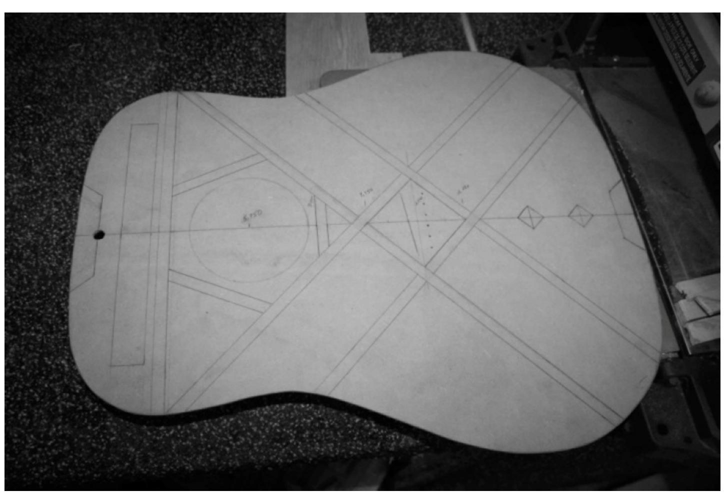
To transfer the template to the wood, carbon paper can be used under the drawing, and the drawing traced over to transfer the image. If no carbon paper is available, there is another way.

On the drawing, use a pencil to trace over the outline of the body shape, going over it several times to transfer a lot of lead onto the paper. Flip this paper over and lay it on the wood being used for the template. The lines should be easy to see through the paper, and can be drawn over again to transfer the lead from the other side to the wood. Be careful not to move the paper while transferring the drawing to the wood because it will distort, and not make a very good template. Remove the

paper, and darken the lines that were made on the wood. This is how to do the main body outline.



The next step is to cut that piece out, making sure to be as accurate as possible. A template is only as good as the time taken to make it, and making a bad template will make bad guitars while using it. Cut out the guitar shape using a band saw or jig saw and get as close to the drawn lines as possible without going over them. Then, using a sanding block or spindle sander, gently bring the outside edge right up to the line. Lay this piece on the original drawing to check the accuracy, and refine any areas that need it. Once satisfied, the piece can be marked with the brace locations and measurements.

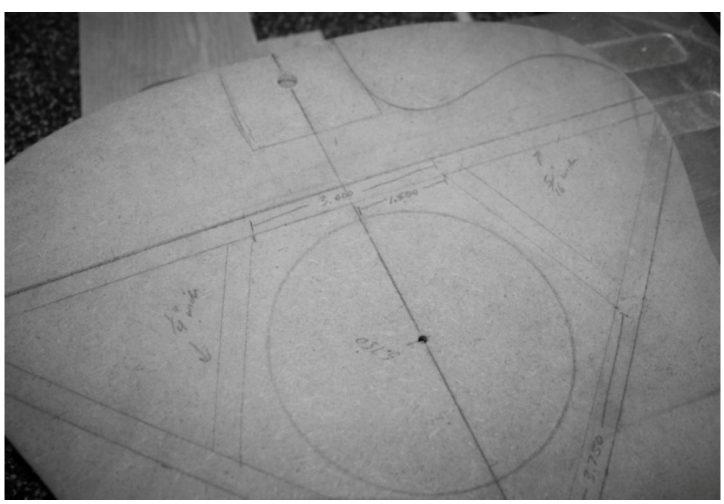


Mark an accurate center line that goes from the top to the bottom of the guitar, to help keep everything uniform and even. Then, following a drawing, mark the layout for the soundhole. This can be taken from the same scale printing that was done earlier, however having a diagram of a standard bracing layout will really help to get them all accurately placed. Once the soundhole center is marked, use a compass to trace the actual soundhole shape on the template.

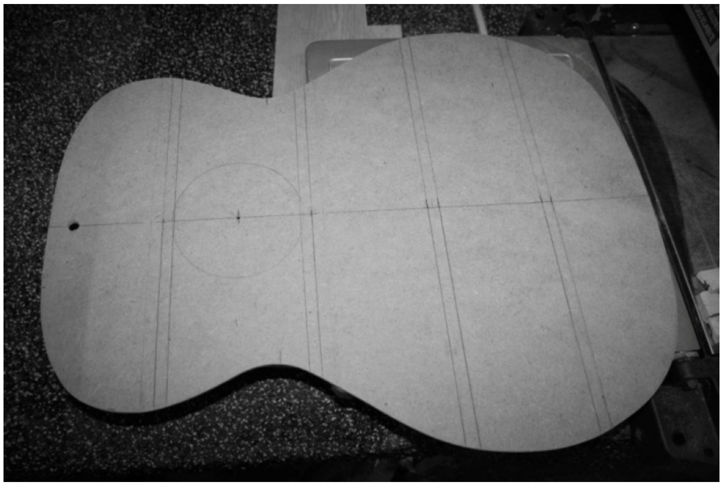
After the soundhole, mark the location of the bridge. This will be determined by the scale length of the guitar being made. The general placement of the bridge is measured from the 12th fret on the guitar, and is the same distance from there as it is from the nut to the 12th fret. Everything else will be derived from the locations of these two items.

Plot out the x-brace locations next, as these are the main braces on the guitar top. The upper horizontal brace goes in after, as well as any grafts above it. Next, add the lower face braces and the small finger braces. Add the bridge patch location, and finally place the top and end blocks. Check the diagram or reference for the layout often, to make sure the template remains accurate and correct.

Make an effort to draw the widths of the braces the same as how they will be on the real guitar top, because these widths will change the locations of other braces. Also, mark as many measurements as possible on the template, which will help guide placement on the guitar top later on. These include things like the distance from the top of the guitar where the neck attaches to the center of the soundhole, and the distance from the top to the bridge.



The above picture shows some of the measurements around the soundhole for placing the braces. These measurements make it easy to put the braces on the actual guitar top, because they do not have to be looked up or figured out each time.

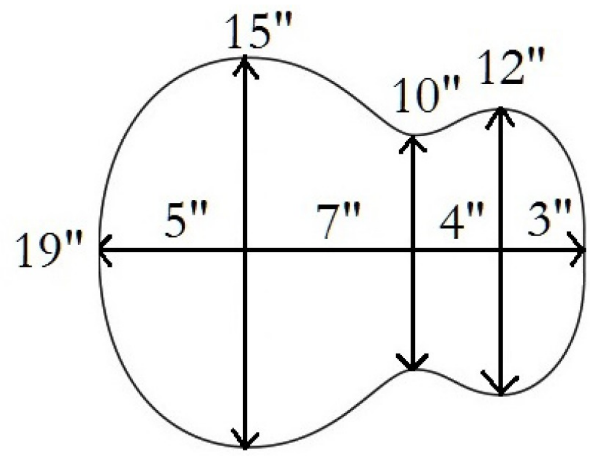


Once the top layout is completed, flip over the template and draw the layout for the back braces on the same piece. The top and back are normally the exact same size, so a double sided template will be very accurate.

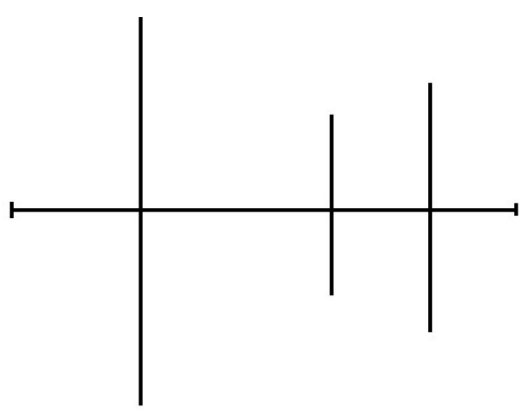
Mark the location of the soundhole again first, because the interior braces on the back can be seen through the soundhole. This will help create a layout that allows the back to be braced well, and the label to easily be seen through the soundhole. Mark the measurements for the distance of each brace from the top of the guitar so they can easily be plotted on the guitar back in the future.

Once both sides have been laid out and the measurements verified, drill a hole near the top through what would be the neck block area so it can be hung for storage.

In the event that a decent diagram is not available, the following will serve as a guideline for creating the template. These values are all rounded numbers, meaning certain guitars might be slightly smaller or larger, but this will make a fine example of an orchestra model guitar.



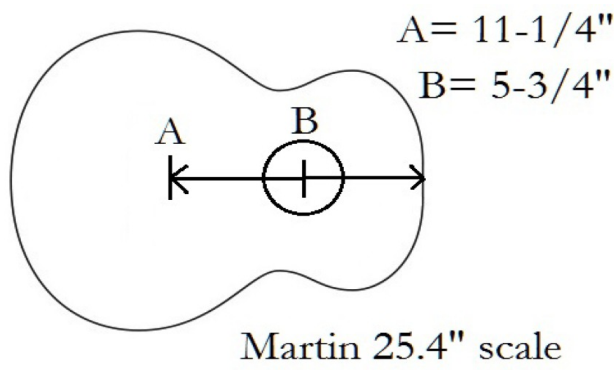
The first diagram shows the basic layout for the guitar outline. This guitar is 19" overall from top to bottom, and that dimension is broken down at three major points. The first point is the widest part of the upper bout, which is 3" from the top and 12" wide. The second break is for the waist, which is 7" from the top of the guitar and 10" wide. The lower bout is the third break, which is 14" from the top and 15" wide.



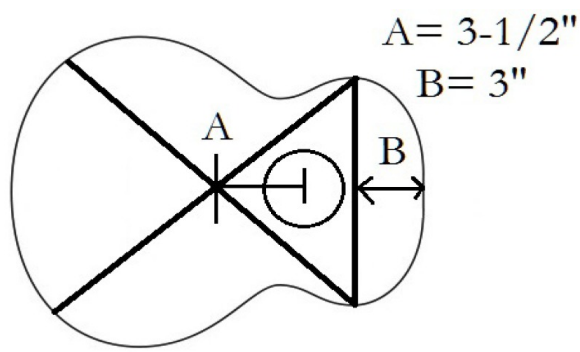
Plot a center line down the piece of wood being cut into the template, and mark a point for the top of the guitar. This would be where the neck attaches to the body. Measure over 3", 7", 14", and 19", and mark all three locations on that same center line. Using a square for a guide, draw lines perpendicular to the center line that are 12", 10" and 15" long, split in the middle by the line. This means the 10" line would have the center line going through it at the 5" mark.

This is where the artistic portion of the exercise comes in, and the guide points will now need to be connected with nice graceful curves, until a satisfactory guitar shape is drawn. Take the time to get a shape that looks nice, as the lines can always be erased and re-drawn.

A trick is to draw one side, and duplicate it on the other side by using the tracing method shown for making custom headstock shapes in this book. This way, the two sides will be symmetrical without having to hand draw both parts.



The next step after the lines have been drawn is to mark the locations for the soundhole and the bridge. For a Martin standard scale length, the soundhole and bridge should be placed 5-3/4" and 11-3/4" from the top end respectively. The soundhole can be traced around the mark at about 4" in diameter, and the bridge location serves as a guide so the braces do not get drawn on too close. The actual bridge location will be far more precise, but for the template this is fine.



The upper brace is drawn on 3" from the top, and the center of the x-brace should be 3-1/2" from the center of the soundhole. Once these braces are plotted and drawn on the template, the rest will fall into place based on these first three. This is enough information to make a template that can be used for many guitars. Also, the measurements can be adjusted very slightly to make a completely custom template that is very unique, and a totally original design.

BRIDGE TEMPLATE

Having several templates for different bridge patterns can be very helpful for several reasons. Just having a few templates on hand will make the bridge more of a decision than it currently is, meaning more thought will go into it. Having a few shapes on hand will also increase the variety and style of bridges being created. Finally, a template means that every bridge made from the same template will be the same dimensions, which will make the guitar look more professional and uniform.

Templates can be as traditional as desired, or be completely unique and very different from the normal. The upper bridge shape is very similar to the standard shape, with a little less depth taken off to make the wings on the ends. The bottom bridge shape is very sharp and a little on the odd side, but it may work in some cases.

These two bridges are different, in that they are more curvaceous than most bridges. The top is a simple variation on the standard with more elongated curves. The bridge below it takes some measuring to make sure there is room for the bridge pins and saddle, however it is curved on both sides, and offers a different look still. Any of these shapes will make a fine bridge as long as a couple rules are followed while making a custom shape.

The bridge being created should have about the same mass as a standard bridge, which will minimize the chance of trouble by creating something too big or too small. Getting out of the standard a little is fine, just do not make any dinner plates or toothpicks. Also, there needs to be enough area under the bridge that a good glue joint can be made to hold the bridge in place for a long time. Removing wood reduces this, which means a weaker joint. Lastly, the bridge must have enough space in the middle that the saddle and the bridge pins can be routed and drilled for. These items have to fit, no matter what shape the bridge is.

Several designs can be worked out and made into templates at one time, or they can be made on an as needed basis. Many times a different looking bridge will be made for a certain guitar, which is a good time to make a template before gluing it onto the soundboard.

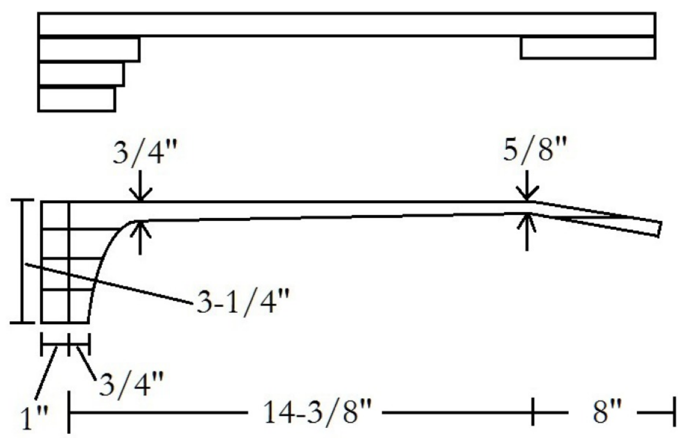
Drill a hole through each template so they can be hung on a peg board and kept together. This will make them easy to access which means they will be used more.

Having a choice of several bridges sometimes leads back to a variation on the original style. The guitar in the picture above has a large soundboard and a deeper than normal body. The bridge was intentionally made a little smaller than normal, which also helps make the guitar look visually larger. The wood for the top was the real showcase on this build, so choosing to downplay the bridge a little helps keep the top as the focal point.

Small decisions like these pay off in the long run because they make the final look of the guitar more professional, and look like more thought went into it.

NECK PROFILE TEMPLATE

Another useful template to have, especially if most guitars are going to be made with the same scale length, is the neck profile template. This handy item makes marking the locations for the nut, dovetail, and neck taper very easy. It eliminates measuring every time, and is helpful in finding the best place on a blank to cut a neck from.



The diagram shows a stacked neck blank on the top, though this template can be used on any type of blank. The bottom neck with the dimensions is how to construct the template.

This template is best made from 1/8" MDF or plywood, but can really be made out of any scrap that is large enough. Trace the outline on the piece of wood, making sure to get the dimensions as accurate as possible.

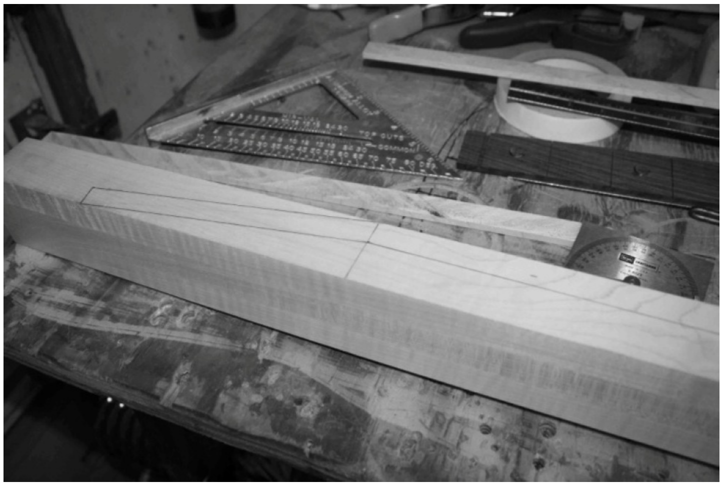
On this template, the thickness at the nut is 5/8", and the headstock falls back on a 15 degree angle. The taper gets larger until it reaches the area of the 12th fret, where the wood reaches a thickness of 3/4". The total distance the top of the neck needs to run is 14-3/8", which will leave enough wood to join the guitar to the body at the 14th fret on a Martin standard scale length, plus an inch for the dovetail joint if there will be one. There is also 1/4" allowed for the nut to be placed at the end of the

fingerboard, and about 1/16" of wiggle room to get everything lined up well.

The heel and the left over portion will vary based on how the guitar is going to be designed in the heel area, and based on what method of attachment will be used. A dovetail needs an inch of wood or less to attach it to the guitar body, but a dowel joint will need no extra wood past where the 14th fret would be located. In the diagram, the vertical line an inch from the end in the heel area is the location of the 14th fret.

If the heel needs to be larger or smaller to accommodate a certain design element, it can easily be incorporated into the template by adjusting the measurements a little bit.

On the stacked neck blank, taper the headstock down at 15 degrees and make it as long as it can be, because it can always be shortened later on in the build. It is better to have a slightly longer headstock and cut some off than to have a short piece and wish more was there. This will also allow for more elaborate headstock options should they be desired.



The picture shows the lines drawn on the side of the neck using a template, and also shows what is meant by making the headstock go all the way to the bottom of the board. This headstock is definitely too long, but again it is better to have more wood. The template makes this neck very repeatable and easy to duplicate. All the necks made from it will be the same, and they will have a more uniform and professional look to them.

Project Notes:

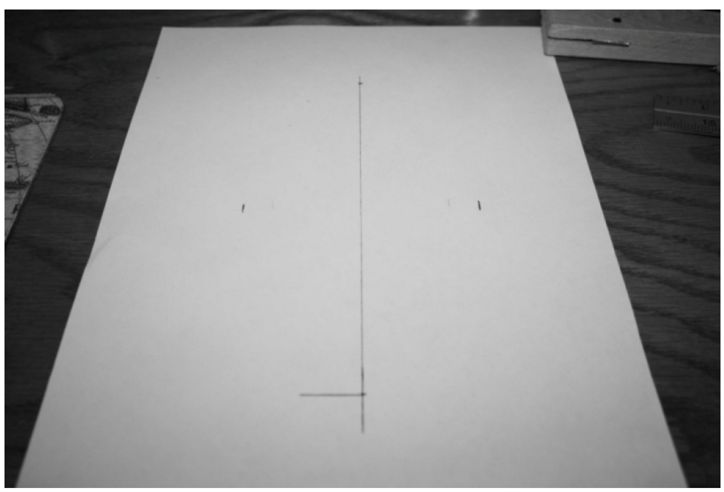
The taper on this neck can be altered to suit the style of the player who will be using the guitar. A thicker neck only needs to have between 1/16" to 1/8" of material added to the nut and the 12th fret measurements to have an impact that can be felt by the player.

Most truss rods are installed in a slot that is about half an inch deep at the maximum. This is done so the area of the neck near the peg head does not have to be very thick. At the bent end of the rod, there will still be anywhere from 1/8" to 1/4" of wood left between the bottom of the truss rod slot and the outside of the neck. This is plenty to have a good functioning and solid guitar neck, just do not route any deeper than the above measurements.

CUSTOM HEADSTOCK TEMPLATE

One of the best places to add a personal touch to the guitar is the headstock. Every big name maker has their own headstock shapes and designs that have become synonymous with their brand. A well designed headstock adds professionalism and personality to a guitar, and makes an instrument that is much more unique. With how simple it is to create a headstock profile, every home luthier should have their own personal headstock design.

The technique for making a symmetrical headstock shape, which is normally found on acoustic guitars, can be applied anywhere that half an image needs to be duplicated. This method of tracing allows one half of the image to be drawn, and then traced over on the other side as a mirror match. This cuts out much of the work in drawing something symmetrical by hand, because only one half needs to be drawn correctly, and the other half is copied.

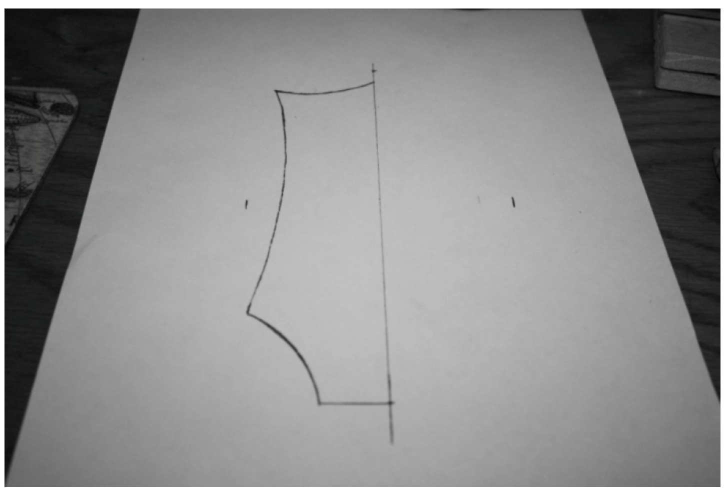


Start with a piece of blank copy paper, the cheaper the better, because it will be easier to see through it for copying. Mark out a center line running from the top to the bottom of the page, which will be the line of symmetry for the headstock. Next, mark a line near the top of the page to

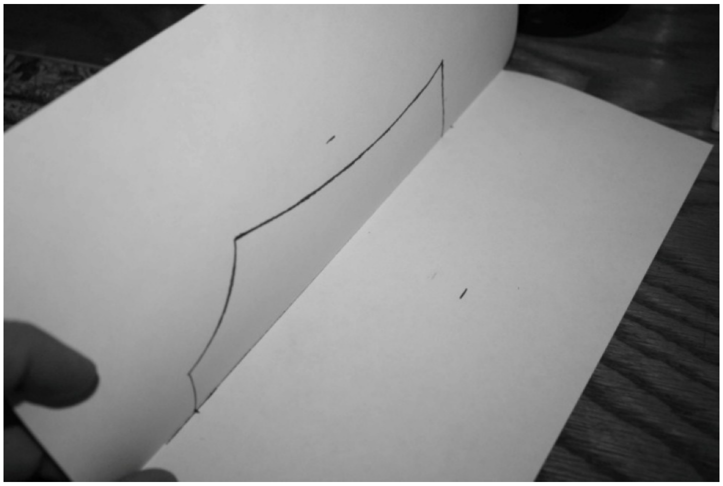
show the maximum height of the headstock. After that, make a mark at the bottom end of the paper that is seven inches from the top mark.

At the nut end, draw a line that is half as long as the width of the neck at the nut, going from the center line to the left. This line needs to be perpendicular to the center line, and extend half the width of the nut. On most acoustics the nut is close to 1-3/4", so this line was drawn in at just under 7/8".

Finally, draw in a couple marks about half way between the top mark and nut mark that are two inches from the center line on each side. This forms sort of an imaginary box that will be the boundaries for the peg head. A guitar headstock can be any size really as long as the tuning machines can operate and the strings do not hit each other. However, having some constraints that keep the shape grounded will help with design.

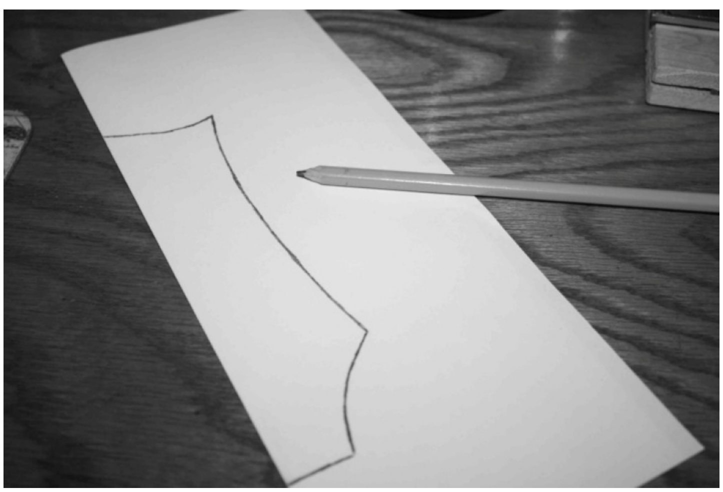


Once the points have been plotted, start drawing out a custom shape. Start at the left most end of the nut line, and draw a curve towards the left, as all guitar necks have this feature where the nut area widens quickly into the actual peg head area. After that, decide whether the sides will be straight, curved, or a little of both, and draw those in as well. The top can be as fancy as desired, or it can be as simple as a straight line back to the center line. Erase and draw the design again if it needs some changes, and once it looks good proceed to the next step.

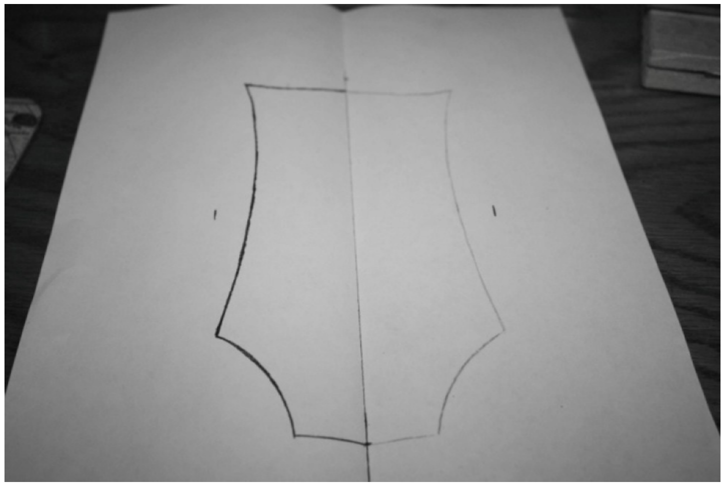


Go over the final lines a few times with the pencil to transfer more lead to the paper. Do not wipe it off because it will be needed in the next couple steps.

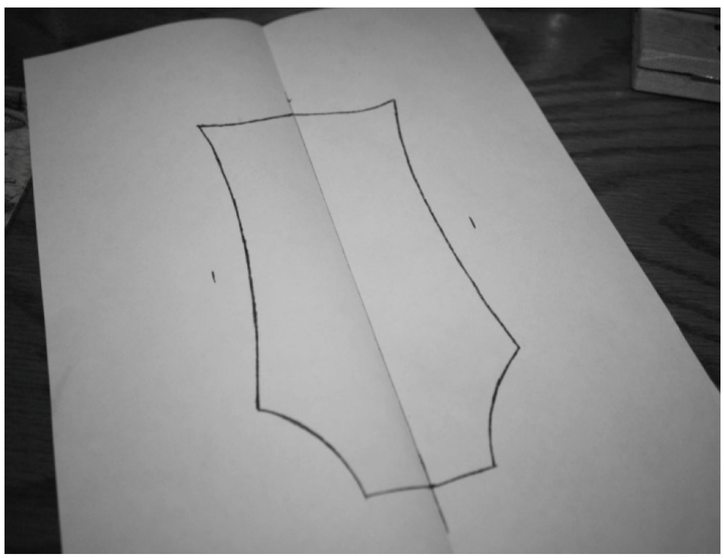
Once the lines are good and dark, it is time to copy it to the other side. Fold the paper in half exactly on the center line drawn earlier. Take the time to get the crease right on the line because this will determine how accurately the drawing is copied.



With the piece folded, the lines from under the paper should be easy enough to see that they can be traced over with the pencil. Press hard while tracing to help transfer as much of the lead from the drawn half to the blank half. Go over the lines a few times with the pencil, and make sure not to move the paper, because this will distort the image.



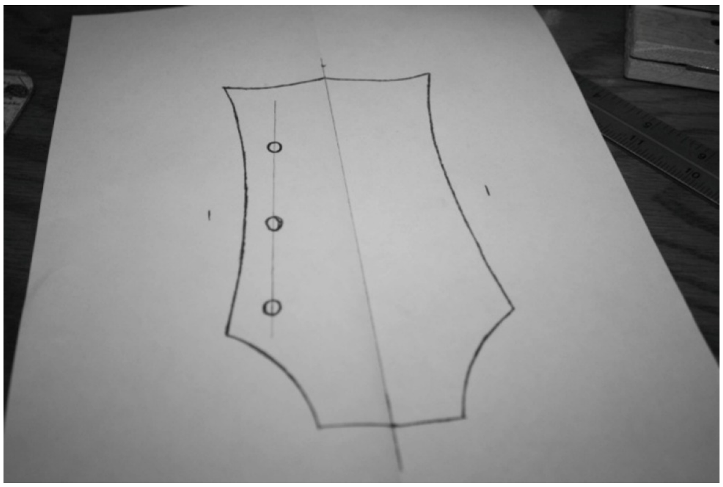
Open the paper to see how well the lines were transferred. In the picture above the lines that were copied are lighter than the other side.



Go over the newly copied lines with the pencil to darken them and make them easier to see. Blend in any gaps that may have happened due to the copy not being lined up exactly, and refine the image if needed with the eraser.

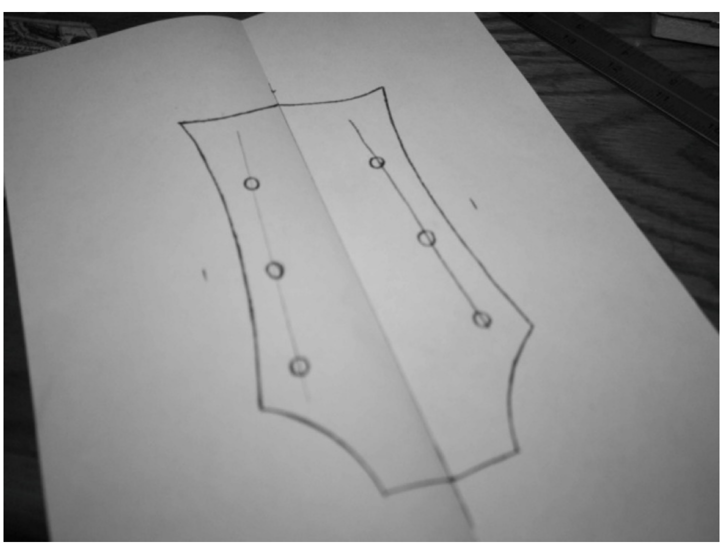
Once this is done, the headstock shape is ready to be used. Copies can be made on a copy machine so they are always available, or they can be made by tracing over the original image. Save the original that was made because it will always be the most accurate.

To use the template, cut out a copy and use some watered down glue to fix it to a piece of 1/8" thick MDF. Once it dries, cut out the shape and sand the edges smooth. This template can then be placed on the headstock of a guitar in progress and the outline can easily be traced around.



Symmetrical tuning machine locations can also be drawn on the headstock template, and transferred over to the other side in the same way.

Draw a line with the ruler on one side, and plot the locations for the tuners long the line. This will keep them straight along the headstock. Fold over and trace again to copy them to the other side.



BRACE ARCHING TEMPLATE

On most acoustic guitars, the top and back plates are domed slightly by arching the braces, which serves a few purposes. In general, a dome is a stronger structure than a flat piece, and contributes to the overall soundness of the design. It also allows the string tension to drive the soundboard better by elevating the bridge to the center of the dome. This can be enhanced by thinning the edges around the rim as discussed in chapter four.

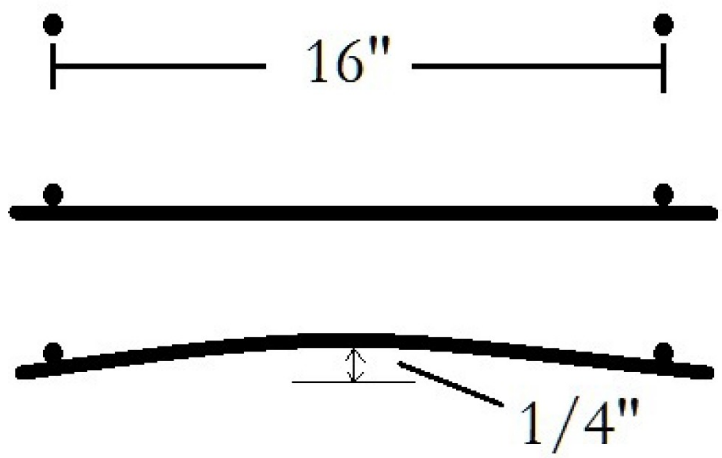
The back plate is far more structurally sound when domed, and serves to capture and redirect sound waves better. The domed shape forces more sound energy back towards the top than a flat back, and thus causes even more vibration.

At first, creating the dome can seem a bit of a challenge, and there is definitely more to it than leaving everything flat. However, the process is not much more difficult, just a little longer and well worth the effort. No special tools are required, only a couple of pre-made arching templates that will be explained here.

The picture above shows my set of arching templates for the 16" dreadnought body style. One is for the top arching and one for the back,

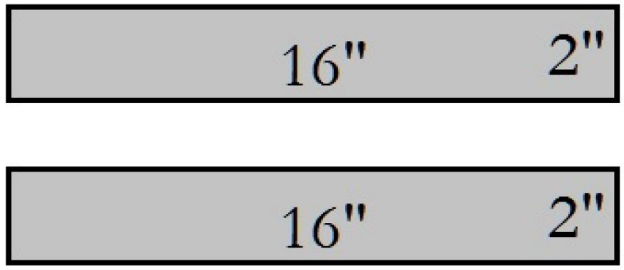
each of them a little different than the other. A set like this is needed for each style of guitar being made, and they only take minutes to create.

The arching template for the soundboard makes a little less of an arch than the one for the back plate, which I like to arch heavily. A top arching of around 1/8" over 16" - 18" is perfectly acceptable, and a rear plate arching of 1/4" to 3/8" over a 16" span is fine for the back. Again, the top cannot be arched too much otherwise the neck angle will have to be adjusted so the string action is low enough to be playable. The back however, can be arched heavily without any real challenges in construction later on.

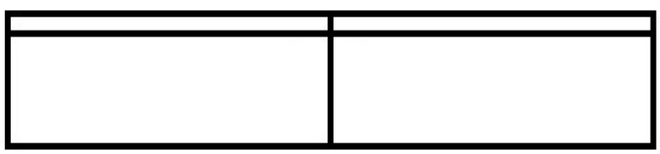


The first part of making an arching template is to learn how to use common shop items to trace out an accurate arch, which can be then traced onto the brace blanks. The first thing that will need to be done is two nails will need to be driven half way into the bench at a known distance from each other. In this case for the back braces, a distance of 16" will be used. Measure out a linear distance of 16" and drive two nails into the surface of the workbench, or a piece of scrap wood.

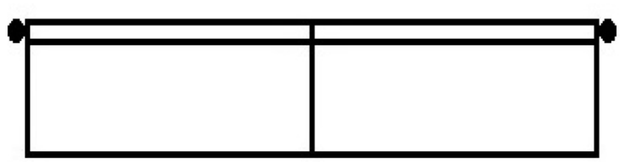
Next, a flat metal ruler that has a little flexibility can be placed on edge below the nails, as seen in the middle image in the diagram above. When pressure is applied from below, the ruler flexes evenly, allowing a curved line to be traced along the length. A certain measured deflection can be held, and a line can be drawn on a piece of scrap wood to be used as a template.



Cut out twp pieces of 1/8" thick MDF that measure 16" x 2", which can be used to make arching templates. If the top or back arching are a different span and deflection according to the plans being followed, cut the two pieces in the length needed for the specific plans. A standard deflection for the back plate is 1/4" over 16" and the top can be 1/8" over 16" or 18". Do not worry about one being any better than the other, and using standard deflections is fine unless a certain set of plans calls for an exact arching.



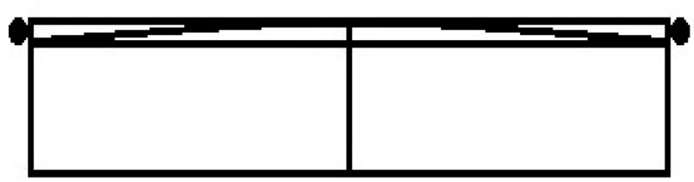
Draw a vertical line down the center of the piece, which will be important for where to measure the deflection from. Also, place a line through the center mark that is 1/4" from the top edge of the template blank, and extends from end to end. This will be the mark that the ruler is bent from, making a template that has a 1/4" deflection over a span of 16". If the desired deflection was 3/8", the mark would need to be made 3/8" from the top edge instead.



Lay the template blank on the bench and drive two nails into the surface on either side of the template. The nails should be just above the

marks, which will allow the ruler to be lined up perfectly along the horizontal line. They should also be touching the edges of the template blank, effectively trapping it between them. The ruler can then be placed on edge against the nails, and the line should barely be visible below it.

Press the center of the ruler upwards as in the diagram on the previous page. Do this until the center of the ruler comes to the very top edge of the template blank. With the ruler held in this position, draw in the arch on the side of the ruler closest to the body (the bottom side when looking at the pictures), and remove the ruler.



What should be left behind is a mark that looks similar to the diagram above, where a graceful and evenly bowed arch is now drawn on the template blank. With this line in place, the template blank can be removed and the waste portion cut off on the band saw.

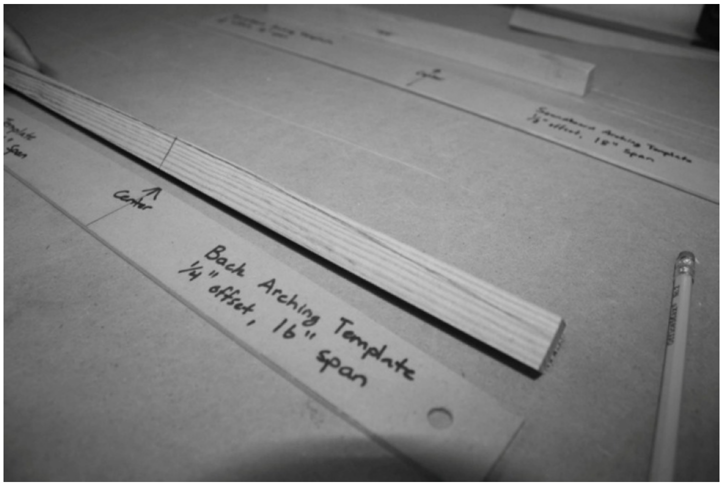
After removing the bulk with the saw, the line can be refined by using a sander or a hand sanding block, going up to the line but not over it. Taking care to make the template correctly will ensure that any braces made from it will also be correct, which is a very important thing. A little extra time on a template pays itself back tenfold later on, when marking out a precise arch only takes a few seconds with a pencil, rather than half an hour measuring.

After trimming and sanding, the template should look something like the above diagram, which is a nice and even curve. Mark the template with the length and the deflection measurement, which will be handy later on if many of these are made for different instruments. A hole can also be

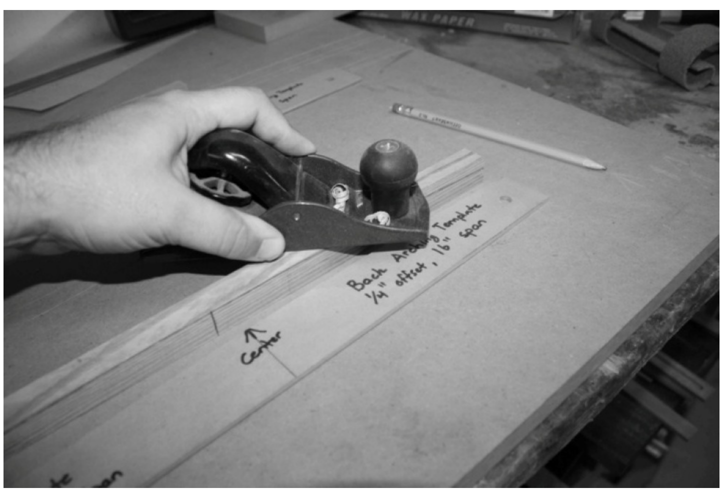
drilled in one end of the piece, which will be useful in hanging them for storage on a peg board. This will keep them in a readily accessible location but also out of the way, considering that they will not be used for anything except marking out the brace arching.

Finally, measure and mark a center line, which will be used later to line up the templates on the braces themselves.

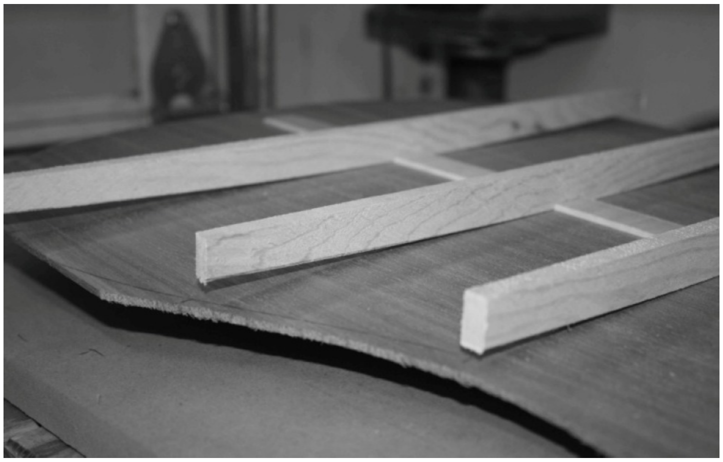
In order to use these templates, the braces must be cut to width on the table saw or by another method before tracing the pattern onto them. Then, they must also be cut to the same length as the template, which in this case is 16". The reason for cutting even the shorter braces near the soundhole and upper bout this length as well, is because it will be far easier to trace out the arch with a full length piece, and it will be far more accurate than eyeballing it. The braces can still be trimmed later before gluing, however for the template to work well they need to be full length at this point.



Mark the center of the brace as seen in the above picture, and place the template over the brace itself. Line the two center marks up together, which should be a perfect match because the brace and the template are both the same length. Line the center marks up so the top edge of the template is at the top edge of the brace blank, and the sides will be evenly spaced 1/4" lower. Draw a line with a pencil following the curvature of the template, and it will look like the picture above.



Trim the waste wood from the brace with a plane, and then follow up with the sander to refine the arching if needed. This can also be done on a band saw, and then again on a sander for cleaning up the curved face.

A neat little trick is to tack glue all four braces together with a dot of glue at the center and each end, and allow them to dry. Then, trace the template on one side and plane them all at the same time. They can even be taken through the band saw and over to the belt sander as a solid unit, and then separated with a knife before gluing. This way all of them are exactly the same size, thickness, and curvature, making the back of the guitar the same way as well. It is a far easier method than doing each one individually, but either way will produce good results if the time is taken.

With the braces cut to length and laid upon the flat back, they will stick up slightly on both ends, as seen in the picture above. They can be glued to the guitar back following the directions in chapter five, which will end up arching the back plate to match the arch of the braces.

It does not take too much more time to make a guitar with arched plates, and the benefits are well worth the small investment of time in making the templates. Once they are constructed, the measuring and setup will never need to be done again. All that will happen is the template will be used to draw in the arching lines on the braces, and they can be cut out and shaped.

Project Notes:

When arching the plates, the back of the guitar can really be flexed pretty far before there are any additional challenges to constructing the body later on. A nicely arched back helps reflect sound back to the top plate, causing it to vibrate more, and create even more sound. This extra

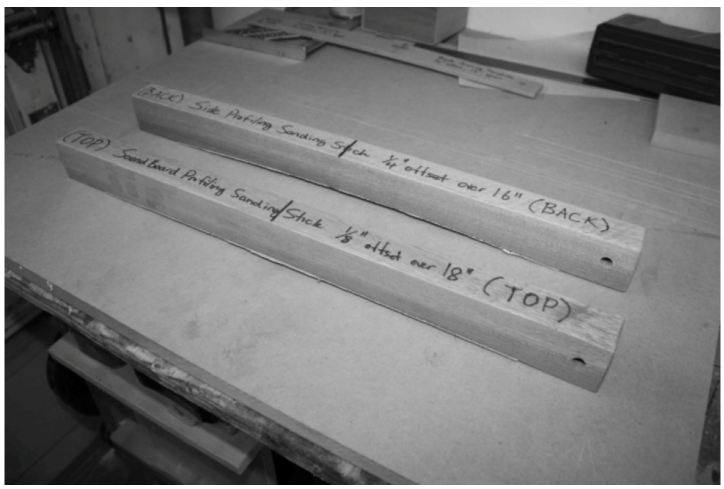
conservation of vibrtional energy will be heard as a fuller and thicker sound.

Also, the look of an instrument with a well pronounced back curve is more appealing than one with a small arch or no arch at all. Sometimes a flat plate can actually look concave instead of flat, and may distract from the beauty of the instrument.

Try making the template and arching a few braces. The process becomes very easy after a few pieces have been carved, and once the first guitar is made with arched plates, every subsequent guitar will also be made in the same manner.

BACK ARCHING SANDING STICKS

When arching the braces, the back plate as well as the soundboard will not attach to the sides as easily as if they were flat. This requires a small modification to the edges of the sides, beveling them slightly for a better fit. This can be done by hand with a sanding block, however it is best to have a tool with the same radius to help the process along.



A back arching sanding stick is a piece of 6/4 wood with an arch sanded into it, matching the template used to arch the braces. A piece of rough sandpaper is glued to the stick, which is then used to bevel the guitar side edges very easily.

All that will be needed to make this tool is a piece of wood that is 6/4 thick, 22" long, and 2" wide, which can be any strong hard wood. The piece will be used on edge, meaning the 2" width will become the overall height of the piece while in use, and the 6/4 thickness will end up being the width.

A piece of 80 grit sandpaper will also be needed, and should be of the best quality peel and stick type available, so that it does not have to be removed and replaced very often. Getting the kind with the sticky back is very helpful because it will not need to be adhered with contact cement or spray adhesive, which makes getting the sandpaper in place more difficult than just peeling and sticking.

A set of arching templates are also needed, which will form the basis for the arch that is carved into the sanding sticks. This template would have been used to arch the braces, which in turn would arch the plates themselves. When the sanding stick has the exact same arching profile, the sides will be perfectly beveled to accept the plates, making an excellent fit

between the two. Plans for the arching template can be found earlier in this chapter.

The process for making the sander is fairly straight forward, and is similar to the creation of the template in the first place. The sticks themselves will need to have a center line marked on them that splits the long length into two halves. This will serve two purposes, one of which to help align the template to mark the sanding stick, and another to help keep the stick aligned while using it on the guitar.

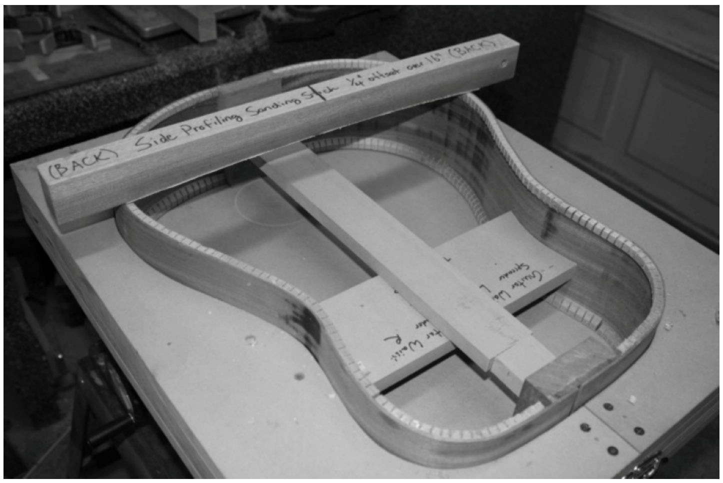
Once the center line has been marked all the way around the center of the piece, lay the stick down on one of the 2" faces. Place the arching template over it, lining it up with the center line that was marked earlier. Use a very sharp pencil to make a line following the curve, tracing the profile of the template onto the sanding stick. Darken the line a few times with the template in place before removing it, which will leave a very clear line to follow.

Cut out the waste portion of the sanding stick as close to the line as possible without going over it, using a band saw or jig saw. Once the bulk of the waste has been removed, refine the edge with a sander or sandpaper and a curved block. The objective is to bring the edge all the way to the line, and smooth out the surface along the cut.

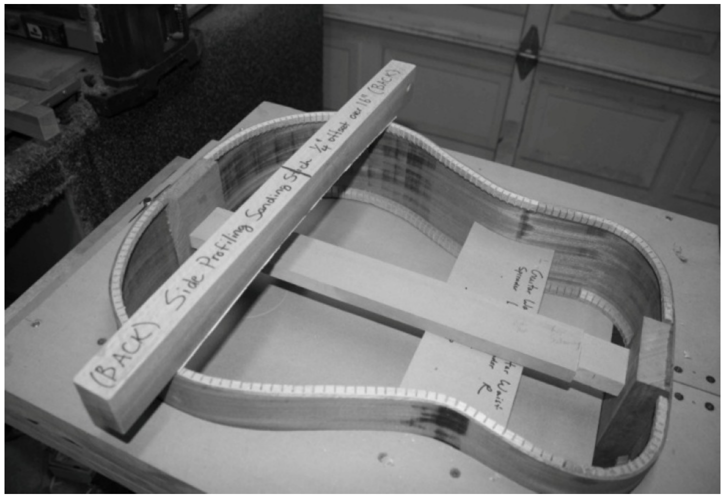
Once the area is smooth and free from any rough spots, attach a piece of 80 grit sandpaper to the curved faces, completely covering them. Peel off the sticky backing on the pieces after they are cut, which is easier than cutting them once the sticky backing has been removed. Place the sticky sandpaper over the curved area, and press it tightly in place.

Peel and stick sandpaper actually adheres better the more it is pressed into place, and the harder it is used. Press very hard while getting the sandpaper to adhere to the sticks, and it will stay there for a long time.

Once completed, mark the size of the offset as well as a clear center line on the sanding stick. Also, drill a hole at one end so the stick can be hung from the peg board, and stored in a safer place than just being stacked somewhere.



To use the sander, the guitar body must have the taper of the sides already in place, as well as the kerfing. If the plates were flat, the body would be ready for the plate to be glued in place. Lay the sanding stick over the body as seen in the pictures above and below. Line up the center line with the center line of the guitar, which will need to be done by eye because there is no place to mark a center line on the guitar itself.

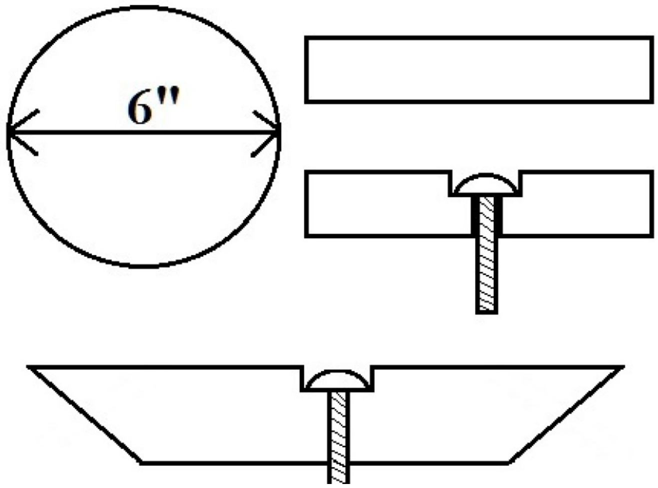


Keeping the stick aligned with the center, push and pull the stick from the head block to the tail block. This will sand the edges as well as the head and tail areas to a nice bevel, which the plate will glue onto perfectly. The beauty of this tool is that the slightly different bevels needed in different areas will automatically be done correctly because of the design of the stick. Sand the guitar until all the exposed edges have sanding marks on them, which will indicate that the process is complete. Finish attaching the plate as normal afterwards.

DISC SANDER FOR BUFFING ARBOR

A useful addition that can be made to fit on an existing buffing arbor is a disc sander. Sometimes the machine mounted disc sander does not allow enough access to the wheel, or a large piece cannot get in close enough to be sanded. Having a disc mounted on the buffing station allows more access to the wheel, meaning an easier time sanding things like bridges, head and tail blocks, and peg head veneer.

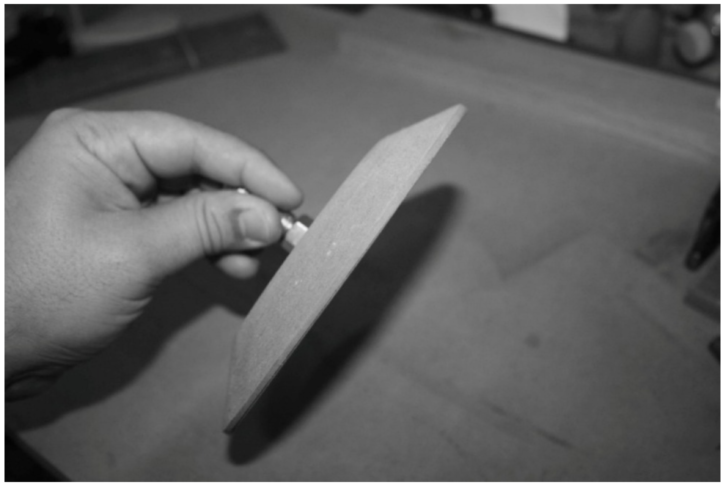
To make the sanding wheel, first decide upon what diameter it will be, which is based on the availability of sandpaper for it. Peel and stick sandpaper discs come in many sizes, though a 6" or 8" piece will work the best for the small work being done on a guitar. These can typically be found at the large home improvement stores, though larger discs may have to be bought elsewhere.



The disc is made from a scrap piece of plywood or MDF, and is beveled backwards to add clearance to the rim of the sander. If the rim was not beveled, it would be difficult to get into the tight spots that it will need to.

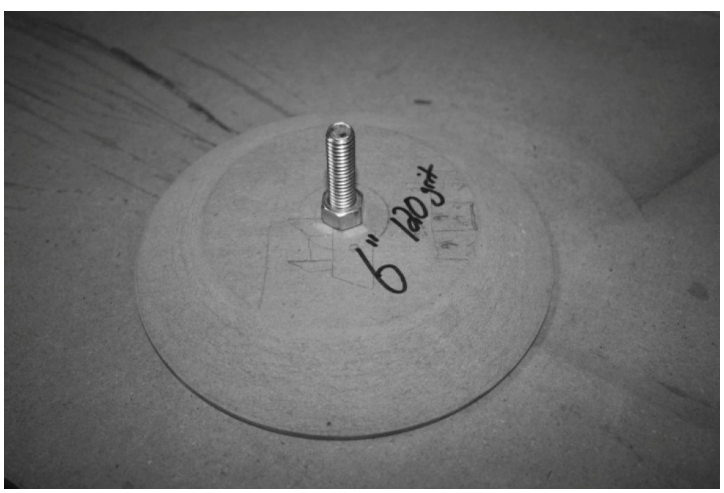
Begin by marking a clear center point on the piece of wood, and then marking a circle that is the same diameter as the peel and stick sanding discs with a compass. Darken this line well, because it will have to be cut out and sanded very close to the line.

Cut out the disc getting as close to the line as possible, and refine the line with sandpaper and a sanding block, to get the edge as perfectly round as can be done. If a lathe is available, it can significantly reduce the time it takes to make the disc round. Drill the center hole first if using a lathe, and turn it round using a chuck to hold the center screw. The center hole is explained in the next couple steps, and is not needed for the non-lathe method.



To bevel the edge of the disc, use a router with a chamfer bit and go around the outside until the bulk of the edge is removed. This removal does not need to go all the way to the face of the sander, and having a small rim left behind is fine. It is very hard to get the chamfer all the way to the face with a router anyway, so get as close as possible (within 1/8") then stop.

If doing this on the lathe, turn the rear edge with a lathe tool until it is shaped like the pictures, again leaving a small rim on the edge of about 1/8".



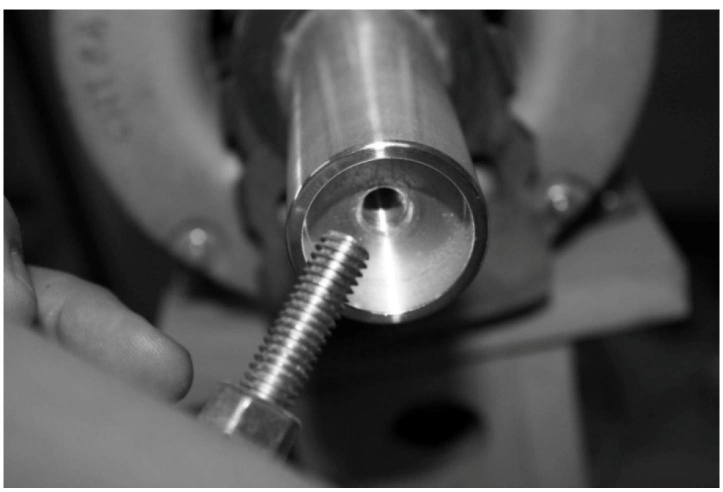
After the disc is shaped, the center hole can be drilled. This will depend largely on the type of buffing arbor that is being used to drive the disc. This happens to be a Beall buffing arbor, so the bolt size is 3/8-16. A machine screw that is 2" long has enough length to go through the wood, as well as thread into the arbor.

The head of the bolt must be countersunk into the face of the disc, otherwise it will get in the way and the surface will not be flat. Using a Forstner bit, drill through the marked center point deeply enough to clear the head of the machine screw. Again, only go as deep as needed, so there will be enough material left at the center point to hold the disc well.

Next, drill a hole that the machine screw fits tightly into, but not to the point where it is breaking the wood to do it. Follow the center point left behind by the Forstner bit, which will keep everything centered. Usually, a hole drilled the same size or one size smaller than the screw diameter will work.

Insert the bolt through the front of the disc, which is where the sandpaper will be attached, and secure it with the matching nut on the other side. Using a crescent wrench, tighten the nut firmly against the wood.

Once the bolt is through, peel off the backing from the sandpaper and carefully place it on the disc, keeping it centered. This might have to be done a couple times to get the placement right, so do not press very hard until the end. Once it is placed well, push it hard onto the wood to keep it in place.



Thread the finished sanding disc into the buffing arbor, being careful not to strip the machine screw as it goes in. Turn it in by hand until the back side of the wood tightens against the rim of the arbor and then snug it up a little more so it is tight.

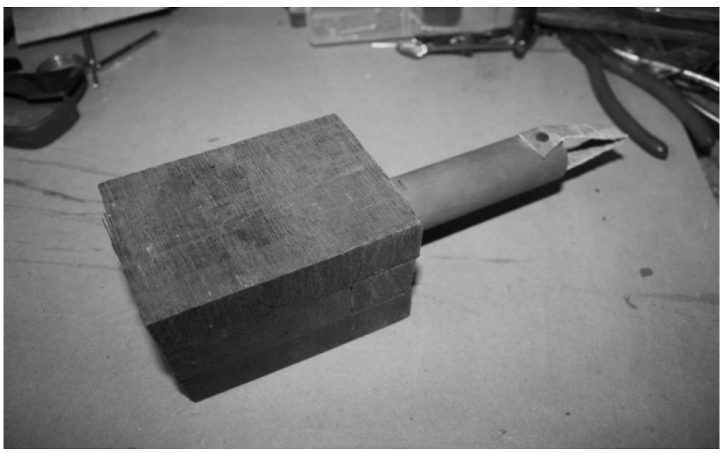
Turn on the machine and check for wobbles, which may or may not be present at all. A little wobble is alright, it just means the center drill

hole was not absolutely perfect, and will not be a huge problem at all. A very large wobble on the other hand, that makes it hard to use the sander, should be dealt with by either trying again from the beginning or sanding the high spots on the disc until it balances better.

To use the disc, simply turn it on and carefully apply the piece to be shaped against the outer edge of the disc. Always work on the outer edges, and use light pressure to shape the wood.

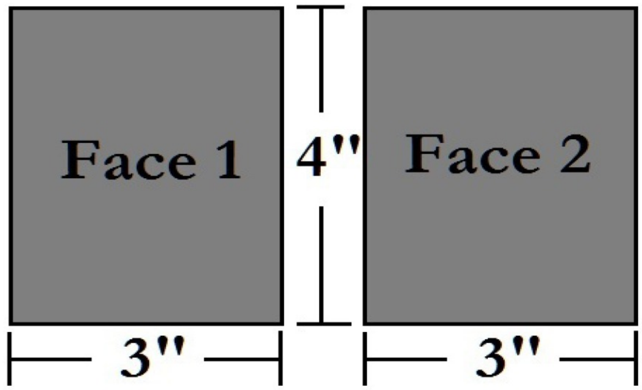
EASY WOODEN MALLET

Often times while using a chisel to shape the braces, it is useful to have a little more force than is comfortable to apply by hand. Having a small mallet to assist with quickly tapering the ends of the braces makes the job much easier and more accurate. Plus, this version of the carving mallet is very easy to make from scrap in the shop.

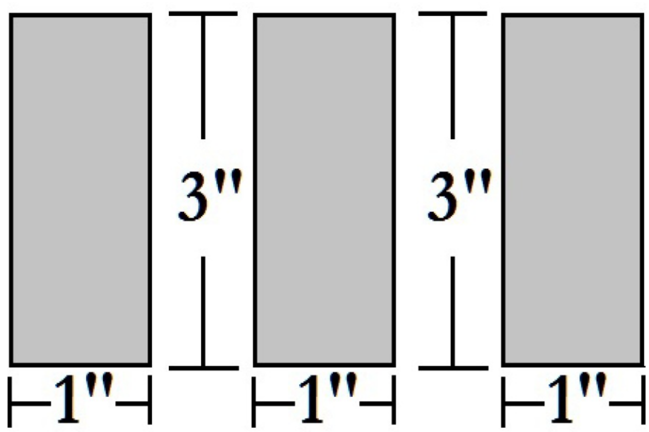


The construction of this mallet is very simple, and only involves cutting and gluing pieces of scrap wood together. The dowel handle eliminates the need to drill a long bore through the piece, which can be difficult without a drill press.

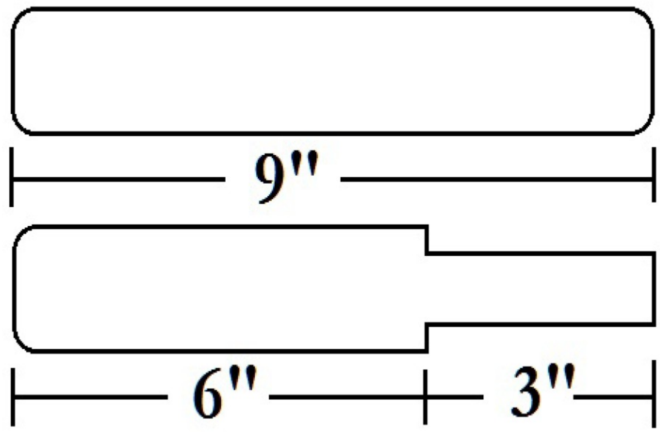
The wood for this mallet will need to be a heavier hard wood, like Lignum, Purple Heart, or Brazilian Cherry. The reason for a heavy wood is that a gentler hit will provide more power if the mallet has more mass at the head. The handle can be made from any species, though a Maple dowel would be slightly better than a soft wood choice. Purchase a 1" dowel to make into the handle.



Cut out two rectangles from the main wood that are 4" x 3". These will be the faces of the mallet, and it does not matter which way the grain runs through them. They should however be flat, and free from defects such as knots or cracks.



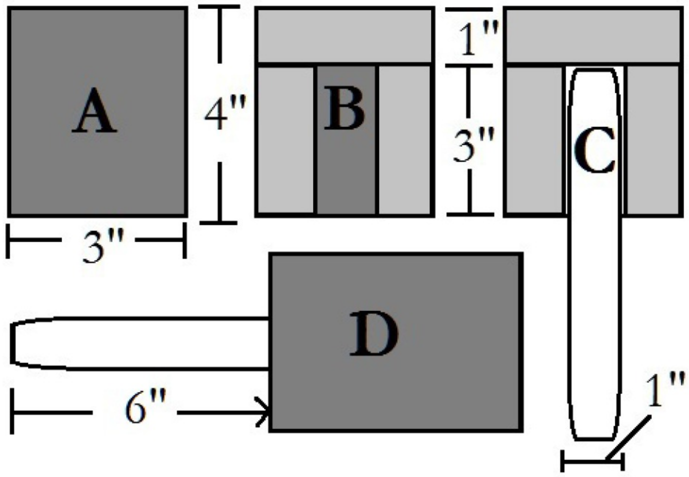
Cut three pieces of the same wood species that are 1" x 3", again not worrying about the grain direction as much as the pieces being defect free.



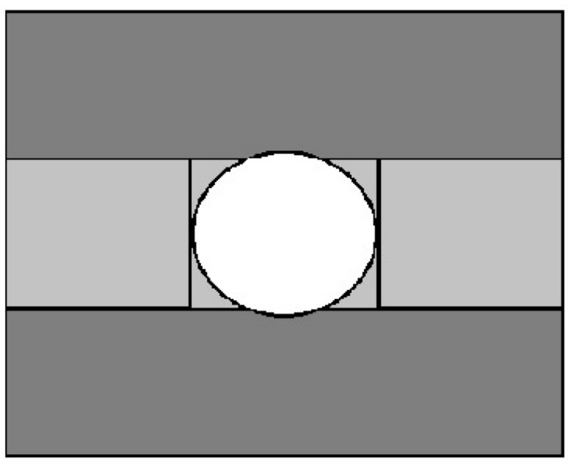
Cut a length of 1" dowel that measures 9" long, which will allow for a 6" handle. Cut the piece a little longer if a longer handle is desired, though this is a very good length to start with.

With the wood being 4/4, which is a little smaller than 1" thick, the two faces of the dowel will need to be flattened a little with a file so the mallet can be assembled. Do not worry about filing it now, wait until the dry fit in order to see how much wood actually needs to be removed. The diagram above is slightly exaggerated so it is easy to see how the wood will be shaped. In reality, only about 1/8" of wood will need to be removed from each side to fit between the mallet faces.

Now that all the pieces have been gathered, it is time to do a dry fitting to test how they all go together before gluing. The main point in the dry fitting is to assist in filing the dowel handle so that the pieces all fit flush for gluing. Also, a dry fitting in general for most projects is a good idea, because it can help identify problems before glue is smeared all over everything.



Lay one of the mallet face pieces on the bench as shown by picture A in the above diagram. On top of it, arrange the three smaller pieces of wood as in picture B. Lay the dowel in the middle section as in picture C, and then cover it all with the other hammer face as in picture D. This is the basic construction of the hammer, and all that remains to do now is file the dowel handle where it goes into the mallet head, and glue it all together.



The bottom of the piece will look like the above picture with the handle inserted. The dowel must be filed on the two areas that touch the mallet faces, so that the blocks that make up the hammer can be stacked on top of each other without any gaps. In the above picture, the center circle is the bottom of the mallet handle, and the top and bottom extend slightly over

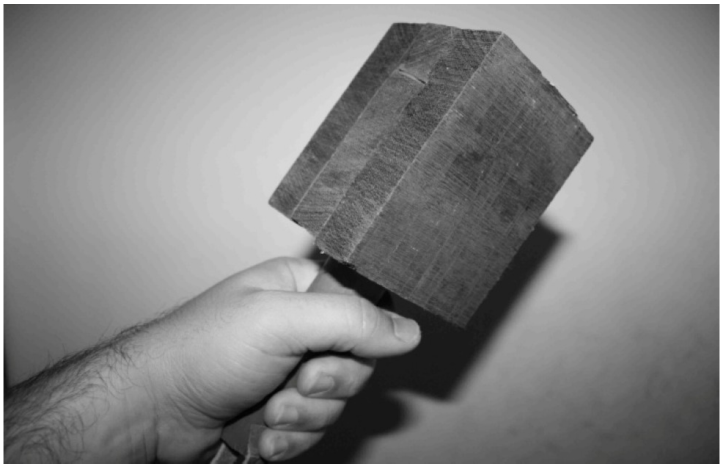
the mallet faces. This is because the top 3" of the dowel have had two places opposite each other (in this case top and bottom) flattened before inserting into the head of the mallet.

Once everything fits well, and the pieces of the mallet head and the dowel can all fit together without any gaps, the piece is ready to be glued together.

Take off the top piece and remove the dowel, making the remaining pieces look like picture B from the earlier diagram. Start by gluing these to the bottom piece with Titebond wood glue. It is not necessary to complete these gluing steps with drying time in between for each one, as the entire piece can be assembled and glued at once.

Next, place the dowel in position and drip a little glue on the sides and areas where it will touch the outside wood. Finally, attach the other face on top of everything with a generous amount of glue.

Clamp everything together using any clamps that are available, making sure that the pieces do not shift while they are being held. Use as many clamps as needed to hold all the pieces in place, and check that the handle does not slide out while the glue is still wet.



Once the glue is dry, remove the clamps and clean up any squeeze out that may have dripped along the faces of the handle. Give the handle a pull to make sure it is well glued into the hammer faces, and that it will not fly off while working with it.

To use the mallet, tap it against the back of a chisel or gouge gently, and the mass of the hammer will provide the power to help move the

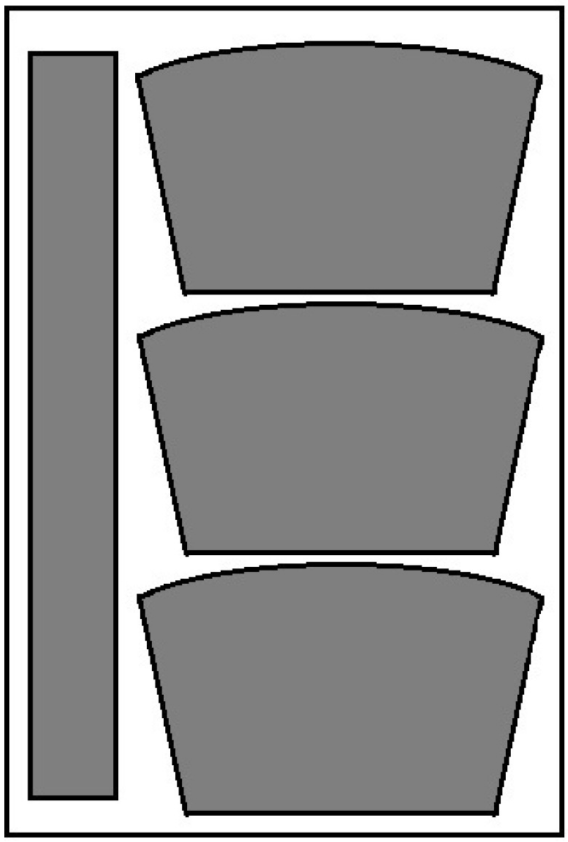
tool through the wood. This tool should be used with more of a bumping action than a hammering action, which will produce better results with less accidental gouging of the surrounding wood. Even though it is a hammer of sorts, it is still designed to be used an a finesse tool rather than a brute force tool.

Project Notes:

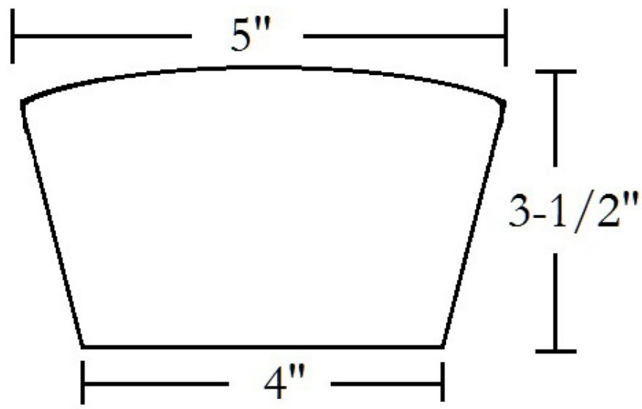
Attaching a small piece of leather or a length of medium sized rope to the end of the mallet with a couple tacks is an easy way to add a hanging loop. This way the mallet can be stored by hanging it from a peg on a pegboard, instead of left on a shelf somewhere.

EASY MALLET TWO

An alternative method to making a square carving mallet is to make an angled face mallet. This type of mallet has a more familiar shape than the previous one, and because of its design is more widely used for carving. The entire mallet can be made from a single piece of 4/4 wood, since all the pieces required are flat.

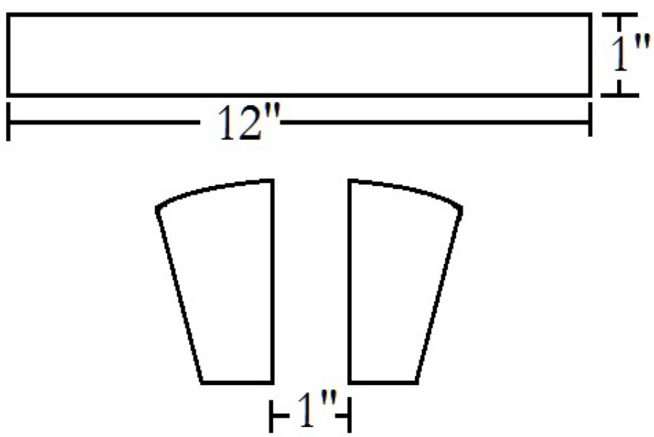


The above diagram shows the only four pieces what will need to be cut out in order to make the mallet, and how they can all be positioned on one board to save wood resources.



The dimensions for the pieces that will be stacked to make the head of the mallet are shown above, and three of these pieces will be needed. They should be cut from a dense species of wood, such as Purple Heart, Lignum, or Brazilian Cherry. Again, having a mallet head with a little more mass helps the carving process.

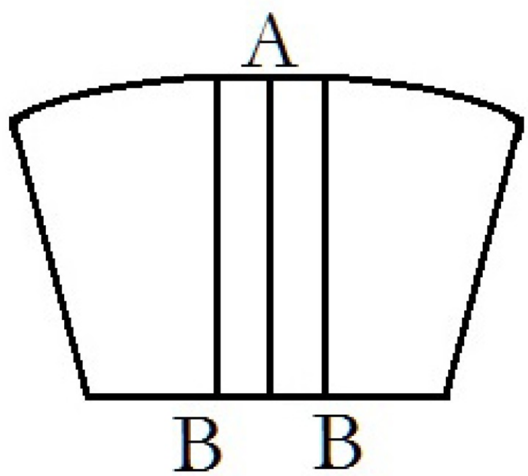
Cut out these three pieces and set two of them aside. One of them will need to be modified a little bit in order to allow for the handle to be glued into place.



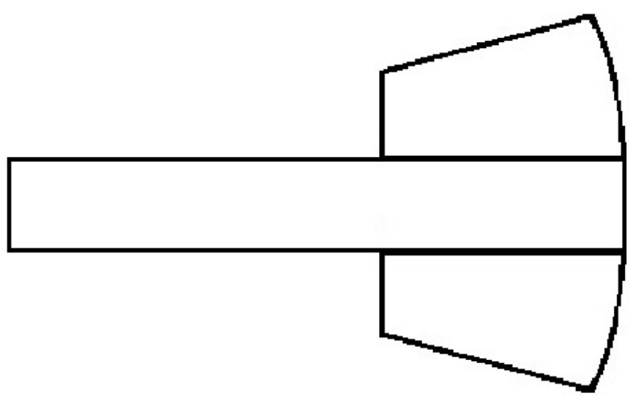
The middle segment of the hammer will need to be have a slot cut through it for the handle piece to pass into the head of the mallet. Since the handle will be 1" wide, the slot must be 1" wide as well.

Measure from left to right on the middle piece and mark a center line. Measure 1/2" on each side of that line, and make a second pair of lines.

These far lines are now 1" apart, which is the perfect distance for allowing the handle to fit.

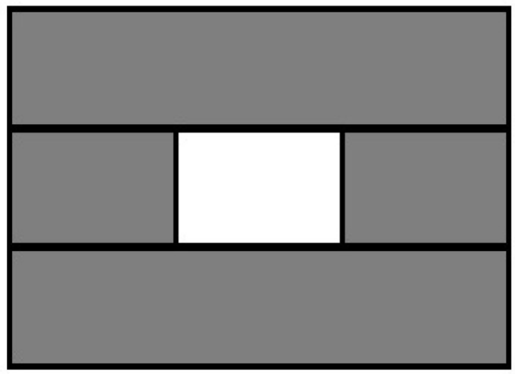


When the lines are marked on the wood, they will look like the above diagram. The center waste material can be removed using a saw, cutting on the insides of the lines. It is not absolutely critical to get the cuts dead on 1" because the faces of the mallet will be sanded flush in the end anyway, which will clean up any differences in width.



The next step is to cut the handle for the mallet from the same piece of hard wood. Cut a piece that is 12" long, and 1" wide, taking time on the long edges so they are as smooth as possible. These can always be sanded later on, however making a cleaner cut will minimize the amount of time that takes.

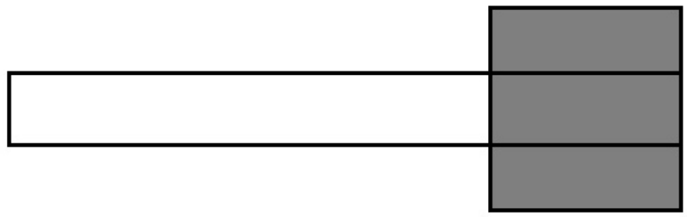
Once the middle piece has been cut apart and the middle inch removed, it can be test fitted against the sides of the newly cut handle to check the fit. If there are any large gaps, sand them out, however small gaps will not cause any problems with the final mallet.

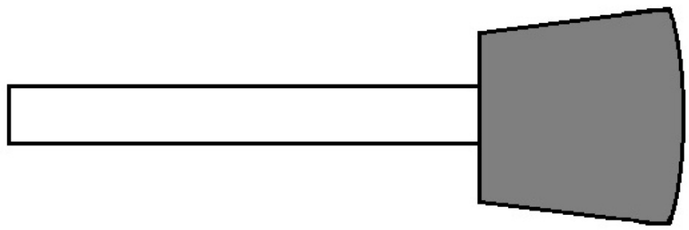


Test fit the top and bottom pieces of the mallet as shown in the above diagram. This is a view from the top, showing the handle in white and the three head pieces in gray. They should all fit together well, and have no large gaps.

The faces of the mallet are on the left and right, and they have a small angle to them as can be seen in the previous few diagrams. These are the faces that will be doing the majority of the hitting, though sometimes the flat of the mallet will be used as well. It is extra important to check these two faces where the three pieces of wood join, to make sure the fit is flush and flat. Large gaps here will cause problems with the mallet in the long run, and should be repaired at this point in construction.

Glue the faces together with the handle following the earlier diagrams, using Titebond wood glue. Clamp everything down tightly, making sure that all the faces are well fitted against each other. Leave this to dry overnight before coming back to it, so that there is plenty of time for the glue to completely cure.





Remove the clamps after the glue has cured, and examine the piece. Chisel or sand off any glue residue, and clean up the mallet.

The faces of the mallet will need to be sanded flat and uniform, which is best done on a power sander of some type. Once the faces are completely flat, the top curve of the mallet can also be smoothed out to look more uniform.

Switch to 120 grit sandpaper by hand and break all the sharp corners on the mallet head as well as the handle. The corners on the handle can be rounded slightly more than those on the head, because they will be held in the hand while using the tool.

Attach a leather loop as in the previous example, or drill a hole through the end of the handle to hang it in the shop.

Project Notes:

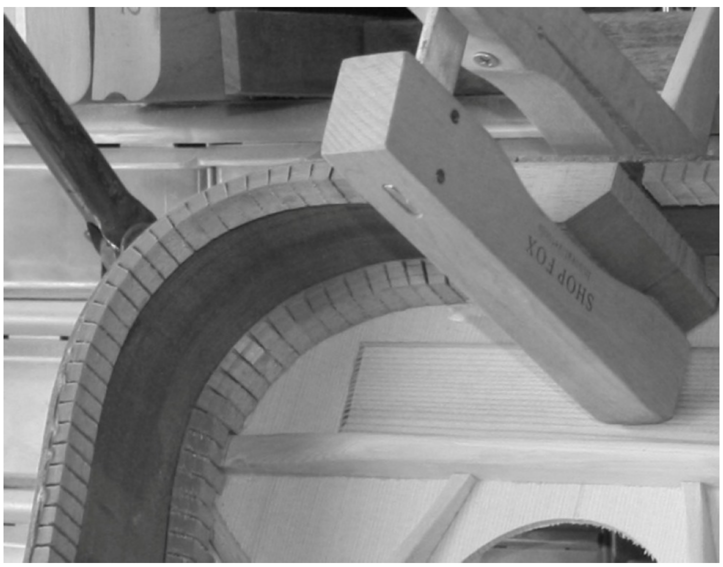
Applying a finish to either this mallet or the previous one is completely optional, however it will make the tool last longer and look nicer.

Use a simple penetrating oil like Danish Oil or Boiled Linseed Oil and coat the piece using a scrap of white t-shirt. Coat the entire surface, wiping all the excess off as it is applied. Hang the tool in the open to dry for a few hours, coat it again, and then hang it to cure for several days.

This simple finish should last a very long time, and protect the tool well.

KERFING JIG FOR THE BAND SAW

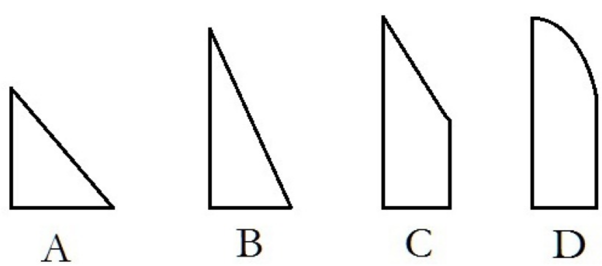
Kerfed linings, also called kerfing for short, are the long notched bendable strips that are glued in the corners where the top and the sides meet. The reason for using kerfing is that the joint between the side and the top is a simple butt joint, and the edges are very thin. This creates a problem when trying to glue two very thin pieces together, so kerfing strips are added to beef up the gluing surface.



In the above picture, the kerfing can be seen around the edges of the sides, where they meet the top and back. Kerfing comes in a few different shapes from the supply houses, but it can also be made just as easily in the shop.

The notches are cut into the strips using a kerfing jig, which allows the band saw to cut notches that are an equal distance from each other. These notches go almost all the way through the strip, stopping short by only 1/16" or less. The strip becomes flexible when all the cuts have been made, which allows it to be bent into place and glued very easily.

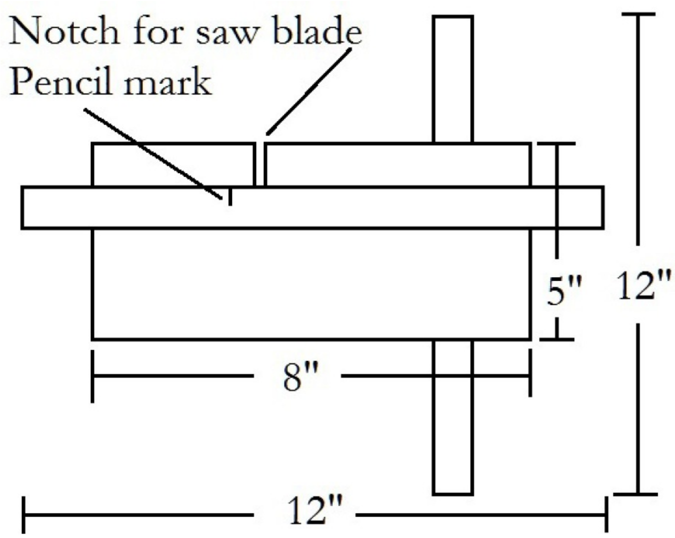
If the cuts were not made, the strip would be very rigid, and break when bent. Classical instrument makers use thinner strips and heat bend them for violins, cellos, and violas. Since the strips on the guitar are thicker and oddly shaped, they have to be done differently.



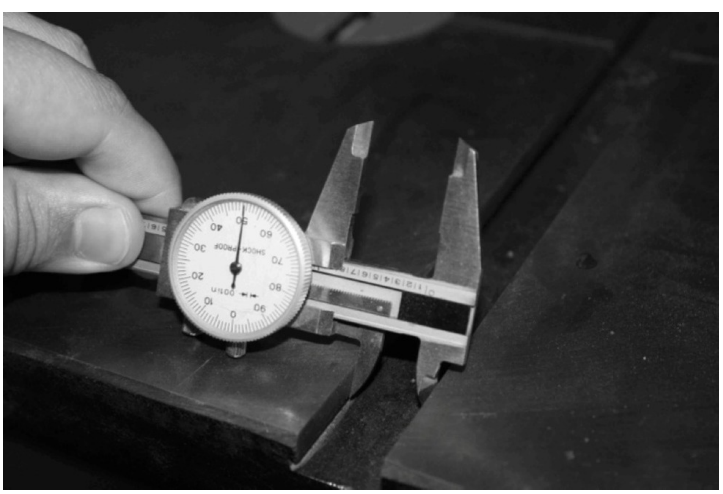
Kerfing comes in a few shapes, depending on what the supply house decides to carry. They all work about the same, and are a personal choice as to which type to use. A and B are triangle kerfing, where C and D are modified rectangles. Type C is the kind of kerfing used in the picture on the left, which is not all that different from type D.

Making the actual blanks is covered in chapter one, and a table saw is used to quickly make many strips from the edge of a board. No

matter which kind of strip is made, the kerfing jig will be used to cut the slots evenly.

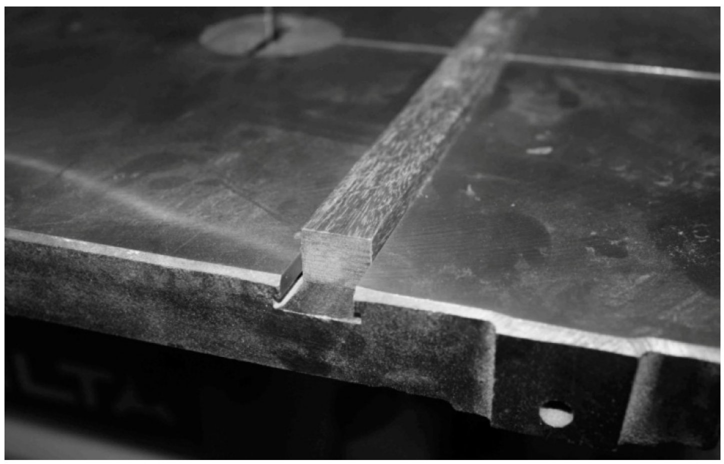


The basic construction of the jig is shown in the diagram above, and it is essentially a wooden platform on a slider. The slider fits into the miter slot on the band saw table, and it can be moved forwards and backwards easily. The jig prevents any motion except forward and backward, and also stops any twisting. A stop is used at the end of the saw table behind the, that limits how far the jig can travel, forcing it to make the correct depth of cut every time.



The first step to making the jig is to make the slide that will run through the miter slot on the band saw. This is arguably the most difficult part in making the jig, because the piece will need to be sanded or planed to a precise thickness. Once this part is done, the rest will require far less precision.

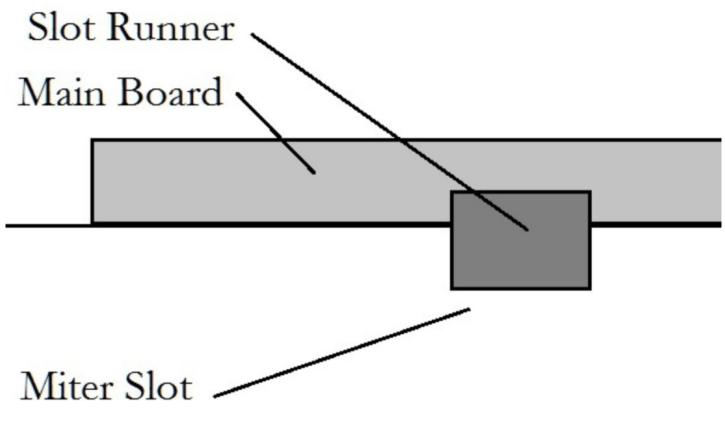
Start by measuring the width of the miter slot using a dial caliper if it is available. Then, cut a 12" strip from the edge of a piece of plywood or other scrap wood that is the same width. The height is not a concern at this point, and can be refined or changed later. The strip should be cut a tiny fraction larger than the slot width, so it can be sanded by hand or planed to a perfect fit.



Test fit the piece in the slot after it has been cut out, looking to see how much material needs to be removed. Use a planer, jointer, or sandpaper laid on the table, to remove a little of the freshly cut area, making the strip thinner. Test fit the piece again and repeat this process until the board just fits into the slot.

The fit should be very close, however it should not bind up or be hard to slide back and forth in the slot. Look for wobble in the strip, which there should not be any, and slide it back and forth the whole length of the track, making sure it does not bind up. The reason the piece is made to be 12" long is because the longer the piece, the more of it will be in the track at one time. With more wood in the track, there is less opportunity for the jig to twist or move side to side, making the kerfs come out uneven.

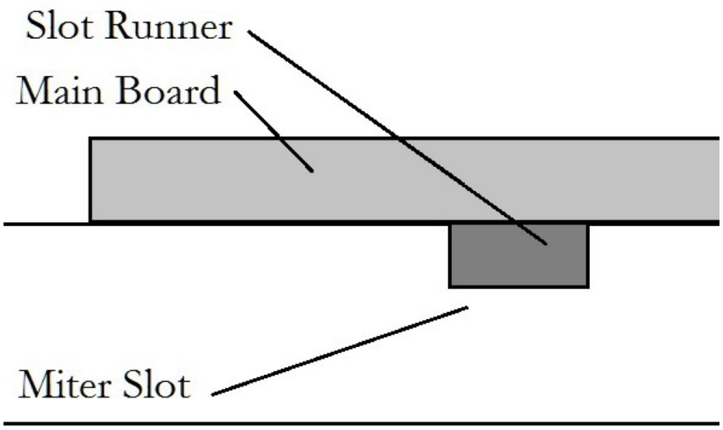
The width of the runner is not given here because it can vary depending on the type of band saw being used. Hobby and bench top saws will have a narrower slot normally, and larger machines and floor standing models a wider slot.



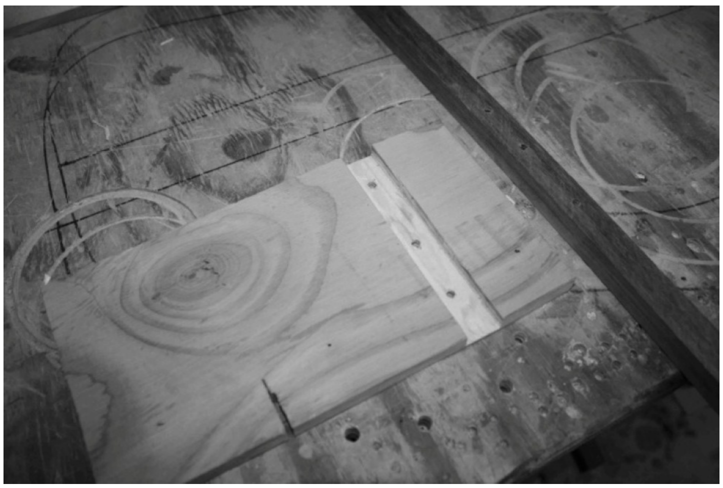
Front View of Bandsaw Table

In dealing with the height of the runner, there are two ways to work with it. If creating a dado is not something that inspires fear, leave the board a little taller than the height of the slot. However, if making a dado sounds like a nightmare, trim the height of the runner to just barely smaller than that of the miter slot.

The diagram above shows the runner taller than the miter slot, which is how the actual jig in the pictures was made, and how this explanation will proceed. The diagram below shows the non-dado version, where the main board will not have to be slotted to accept the runner.

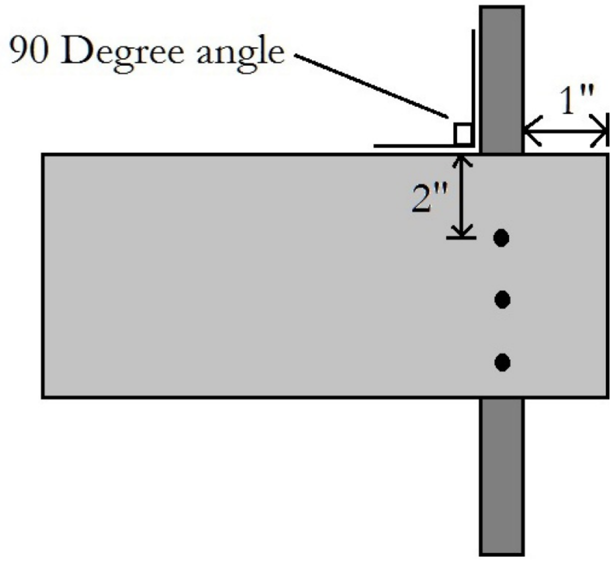


Front View of Bandsaw Table



The main board that holds the runners is made from plywood or other scrap wood, and is 5" x 8" in size. If a very large or very small band saw is being used, the longer measurement on the board may need to change. Smaller band saws may not have a big enough table top for an 8" piece, and a larger professional saw may have a longer distance from the miter slot to the saw blade than 8".

The thickness of the piece does not matter as long as it is thicker than the height of the runner sticking out above the miter slot. If the runner is 1/4" taller than the miter slot, use a 1/2" thick piece of plywood at least. Normally a 4/4 piece of wood or plywood will be thick enough to work with.



Lay the runner in the track and also lay the main board on the top. Use a square to make sure the pieces meet at a 90 degree angle, and that there is one inch of hang off or just a little more on the right hand side. Hold the boards together while squared, and mark the edges where the runner hits the main board on the front and the back.

Flip over the main board and connect the lines using a straight edge. These will be the guide marks used for creating the dado to accept the extra height of the runner. The depth of the dado is the same as the height of the runner over the table top, and can be seen in the diagram on the previous page.

Set the table saw with a dado blade set to the correct depth, and run the piece through to create the dado. This can also be done with a single saw blade, taking many passes which eventually remove the same amount of wood. A router can be set up to make a couple passes with a straight bit to make the dado, and of course it can always be done with a hand saw and chisels.

Test fit the main board on the runner, and place it on the table top of the band saw. Make sure the pieces still line up well, and are square. Also, check that the main board rides flat on the table top, and that the depth of the dado does not need to be changed.

Refer to the first diagram on the previous page that shows the dado detail when looking from the front of the band saw. The darker gray square is the runner, riding in the slot of the table top. The runner is flat against the bottom of the slot, and even with the sides.

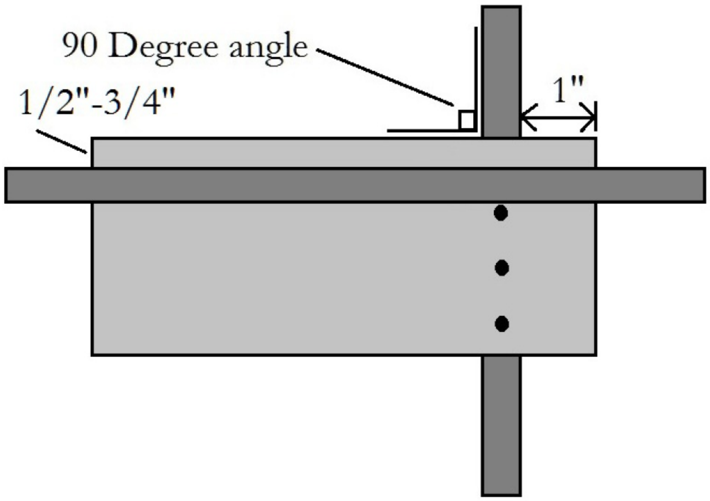
The main board has a dado that allows the runner to set inside it slightly, making the main board able to also sit flat against the table top. In order to have a well functioning jig, the main board must sit flat on the table top, and the runner must also sit flat in the bottom of the slot, or slightly above it.

The sides of the miter slot hold the runner in place, so as long as the runner is close to the bottom of the slot, and the main board is riding flat on the table top, the jig will work properly.

If the main board does not sit flat against the table top, the dado needs to be made a little deeper so more of the runner can go inside the main board. If the dado is too deep, the runner will not sit deeply in the miter slot, so take care and make the needed adjustments to get the dado and these two parts of the jig in the correct place.

Once the jig sits properly, set the square in the corner shown in the diagrams, and square the two pieces. Clamp them down to the band saw table so they do not move, and check the square again to make sure everything is still correct. Using short wood screws, screw through the main

board into the runner in at least two places. Keep these screws closer to the bottom of the jig as seen in the diagrams, because the next piece to be placed will be closer to the top.



The diagram above shows the next piece to be placed on the jig, which is the last part of the construction process. This piece can be any straight stick that is around half an inch tall and 12" long. The thickness (which is seen as top to bottom in the diagram) does not matter much, though something at least half an inch is best.

This piece needs to be square to the runner and parallel to the main board, leaving about 1/2" to 3/4" of the main board sticking out past the front of the jig. This creates a little table and fence where the kerfing strip blanks will sit while they are cut.

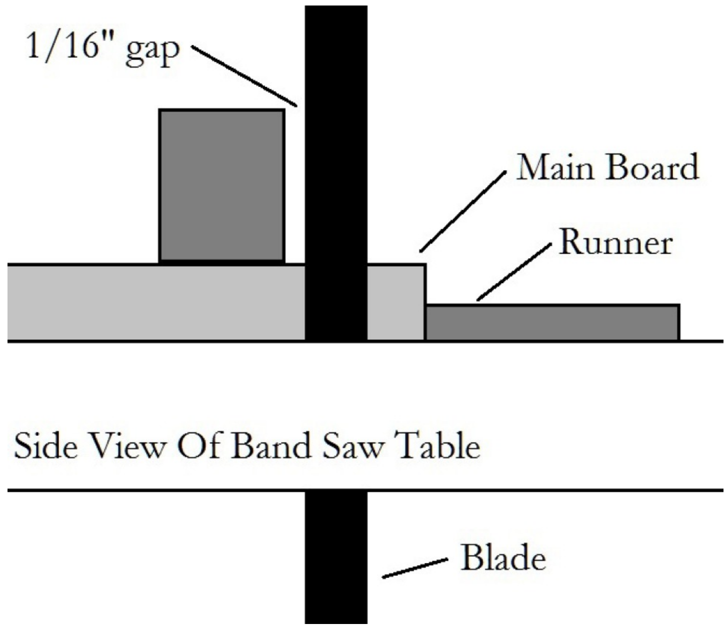
Line up the second long piece in the right place based on the diagrams, and clamp it down tightly. Verify that it is at 90 degrees to the runner, and adjust and re-clamp if necessary.

Drive two or three wood screws into the pieces, locking them together. Drill pilot holes first if the wood is very hard, as running the screws directly into hardwood can sometimes cause a split.

Now that the main construction phase of the jig is complete, there are only a few more details that need to be completed. The notch for the saw needs to be cut, and the measurement marks need to be placed.

Put the jig onto the band saw, placing the runner in the miter slot. Turn the saw on and cut a small notch through the main board and just barely knick the horizontal runner as shown in the picture above. Over time, the slot will widen as more and more of the material is knocked off while using the jig, however it can be widened a little right away with some sandpaper or a very thin file. The reason for widening the slot is to make sure the band saw is not running against the sides over and over, which can dull the blade.

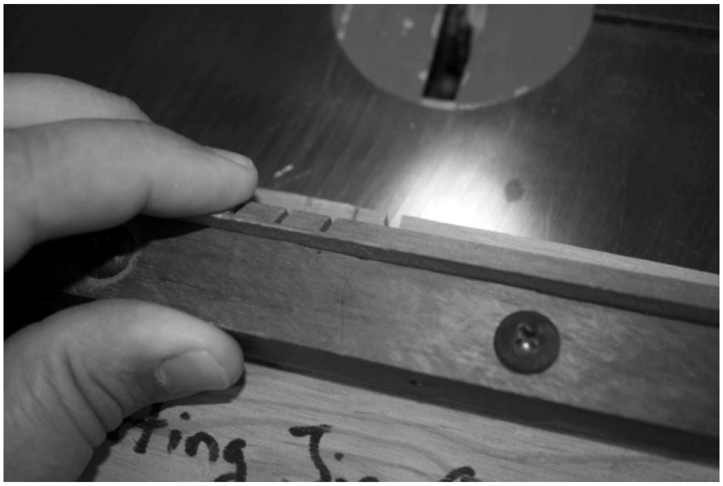
Using the knick that was made in the top horizontal runner, measure 1/4" to the left and make a mark. If the jig is placed on the band saw, the mark would be to the left of the blade notch by 1/4", meaning kerfs that are 1/4" apart will be made by using this jig.



Before the jig can be used, it needs to be set up on the band saw. Place the jig runner in the miter slot, and get it very close to the blade. The diagram above shows a side view of what this will look like, where the blade teeth are within 1/16" from hitting the horizontal runner.

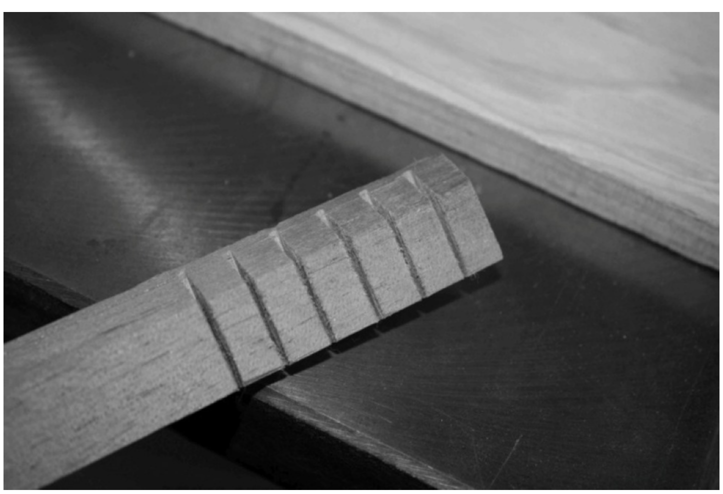
With the blade set very close to the jig, use a small clamp on the band saw table to function as a stop for the end of the runner. This is not clamping down the end of the runner, it is only clamped to the table top. Snug it right up to the end of the runner, and clamp it hard to the table top.

This will prevent the jig from sliding any further forward, meaning the saw blade will not cut past where it was set earlier.



Place a kerfing strip in the jig, with the pointed end up, and the area that will be glued to the guitar sides against the horizontal runner. This is the orientation for all the blanks that will be cut, and it preserves the taller back portion for gluing against the guitar sides.

Make a series of test cuts into the board by pushing the entire jig forward into the saw blade, and then pulling it back. Move the kerfing blank to the left until the end reaches the pencil mark on the horizontal runner, and make the first cut. Move the kerfing left again until the fresh cut is right over the mark, and make a second cut. Continue like this until 6-10 cuts have been made.



Turn off the saw and remove the strip for inspection. Look at the cuts and see if they are going deep enough, or if the jig needs to be adjusted. If the slots are too deep, the piece will break very easily when flexed. If the slots are too shallow the piece will not bend very well.

Getting the depth correct will take a little experience, however as long as the strip is fairly rubbery and the joints are not breaking when bent, the slot depth will be fine.

To make adjustments, simply move the clamp on the table top backwards or forwards to increase or decrease the depth of the cut. Start with very small changes and make a few more test cuts, just like the first time. It may take a few tries to dial it in, however once it is set, it will not need adjusting again.

With the jig adjusted to the proper depth of cut, begin with a fresh kerfing blank. Line up the end of the blank with the pencil mark on the horizontal runner, and make the first cut. Hold the jig like in the picture above, making sure to keep the fingers away from the blade, and the keep the blade guard close to the jig. Push forward until the end of the runner hits the clamp, stopping the jig. Pull back to clear the saw blade by a few inches, and advance the kerfing strip for the next cut.

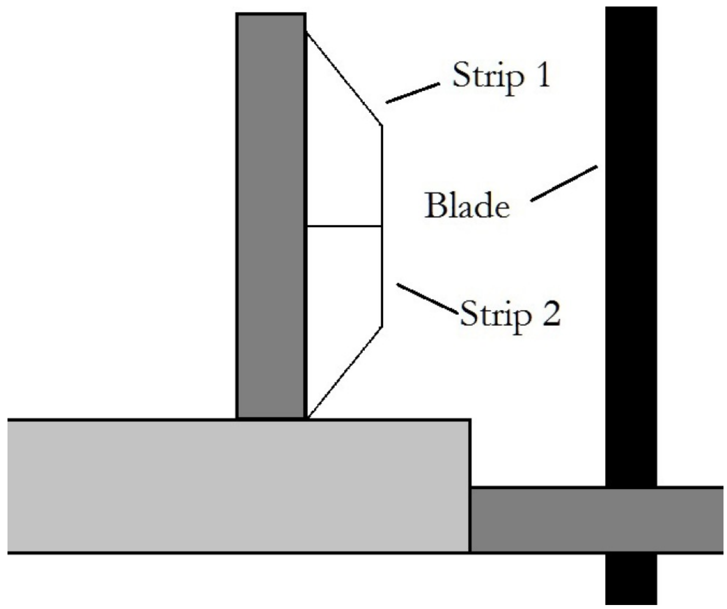
Keep advancing the strip to the left, lining up the last cut made with the pencil mark. If a couple cuts are not made exactly in the right place, it is not a big deal. Just take the time, and keep making the cuts as accurately as possible.

It is a good idea to pull completely back from the saw blade by at least a few inches before moving the kerfing blank. This way the chance of coming in contact with the blade is minimized.

When the strip becomes long enough to reach the spine of the band saw, pull it towards the front of the saw a little, and it will continue to pass along the front side of the spine. Longer strips tend to do this, and smaller strips will not reach that far.

It will take four strips that are around 34" long to do a complete guitar, and while the jig is out it is a good idea to keep on going and do as many strips as possible. Make sure to pay attention while doing this process, because it is easy to get into a lull and make a mistake. It is not so bad if the mistake is on the wood, but the fingers can get it just as easily.

Since this is a time consuming project, sometimes adding a taller horizontal runner will make the project go faster. The taller runner will allow two strips to be ran through instead of one, getting double the strips for the same effort.



The above diagram shows the orientation of two strips, so they can be cut with the kerfing jig together. It is a good idea to place a little masking tape on their backs to keep them aligned well during cutting, because it makes moving them for the next cut much easier.

HIDE GLUE POT

When working with hide glue, it needs to be kept at a constant 145 degrees in an electric double boiler called a glue pot. There are specially made pots that are available at the guitar suppliers as well as online, but one can be made in the shop for a fraction of the price. Since a hide glue pot is essentially a container with a heating element for warming up water, looking around the supermarket there are several items that do the exact same thing.

There are several commonly used items that can be repurposed as glue pots, and all of them can be found in the grocery store. Crock pots, baby bottle warmers, single burner heating elements, and tea water boilers will all make excellent glue pots with a little modification in the shop. One of them however, definitely stands out.

The Hot Pot Express by Rival or Sunbeam is a water boiler used to quickly heat water for teas or soups, and is sold in most stores that sell small kitchen appliances. If it cannot be found in town, it definitely can be found online. There are several features that make this the clear choice for a glue pot, and it will require the least modification to the actual unit.

The number one feature that sets this appliance apart from all the others, is that most of them do not have as fine of a temperature adjustment knob. With a crock pot, there are usually a maximum of three temperature choices. On a baby bottle warmer there are about the same or it is completely automatic, meaning there are none.

The ability to control the temperature is the single most important feature to look for when buying one of these units, because the

glue will need to be kept at a very precise temperature.

If using another type of appliance like a crock pot, or something where the temperature is not as controllable, a rheostat can be wired into the unit, which is essentially a dimmer switch that can help regulate the temperature more precisely. This involves simply breaking the positive lead on the power cord (which should be the non-white wire) and inserting the rheostat in between.

If this kind of electrical work does not sound like fun, just order a Hot Pot and nothing will need to be done. However, if using an existing crock pot or bottle warmer, look online for some minor electrical wiring instructions before attempting it. There is no reason to end up in the hospital or burn down the house over trying to save a few dollars.

As long as the pot is unplugged while working on it, there is usually not that much danger involved when adding the rheostat. However, if the job is done so poorly that it causes a short, there may be some sparks when the unit is plugged back into the wall. If the outlet is the type that cuts its own power when something is wired incorrectly, the chances of being hurt are reduced. If not, it may still trip the breaker, but that is not a guarantee.

Since the wiring will look different on each unit, any instructions here on adding a rheostat will only help a tiny fraction of people. This is why the instructions are based on the Hot Pot, which again is the single best choice out of all the options for an inexpensive hot hide glue pot.

Gather up the supplies needed to mix hide glue, which are a small scale, a couple small paper bathroom cups, the hide glue, a cup of cold water, and a small jar to mix it all in. The jar for the glue should be glass, and nothing metal should touch the glue while it is warming. The bathroom cups make it easy to measure the glue granules and the water on the scale, and the tiny digital scale makes this a simple process as well.

Hide glue granules should be kept in a sealed glass jar when not in use, which can be purchased in the canning section of the grocery store. These large glass jars come with tight fitting and well sealing lids, and are so inexpensive they are basically disposable.

Hide glue is mixed at a ratio of between 2:1 and 1.5:1 water to glue, typically closer to the 2:1 ratio for most instrument makers. This is by weight, not volume, which is an important distinction. Weight is a far better predictor of what will actually be in the solution, where volume can be different depending on what is being measured. For example, a small bathroom cup full of rice will weigh less than if it were full of lead shot. However, one once of each by weight would weigh exactly the same.

Measure out a batch of hide glue starting with the granules. In this example, a very small batch is being made, where on a normal basis at least an ounce of granules should be used to make the process even worth it.

After weighing the glue, weigh about twice as much water, and set both aside to be mixed.

Pour the granules into the jar, then pour in the water, and swirl the contents to make sure all the granules have been covered. In the beginning of the process, the glue will tend to form a lump at the bottom, which is why it will need to be stirred from time to time in order to encourage it to absorb all the water. Leave the substance like it is, mixing once in a while for about an hour, or until all of the water has been absorbed, and the glue looks and smells like decade old gelatin.

The picture above shows the hide glue granules and the water only a few minutes after mixing them together. Be careful not to do mix the stuff too vigorously, which can cause the small hide glue particles to get stuck to the sides of the jar, like in the picture above. If this is done

accidentally, simply use a brush or a small silicone spatula to knock it all back into the bottom. Though it does not smell like it, hide glue is food safe, the same as gelatin, so wash the spatula and return it to the kitchen drawer before anyone sees what happened.

After about an hour has passed, the glue will look like a thick liquid or a chunky gelatin glob, depending on how finely the hide glue granules were ground up from the manufacturer. If they are ground up finely, the mixture will not look chunky. However, if they were fairly large granules, the mixture will have the look of thousands of little tan curds, all stuck to each other.

To prepare the hot pot for use as a glue pot, the only thing that needs to be done is devise a method of keeping the bottom of the glue jar off of the heating element. Direct contact with the heating element is far too hot, since the heater gets much hotter than water in order to warm it. There are a few ways of doing this, all of which are easy and inexpensive.

The easiest method of preventing this is to fill the bottom of the pot with small glass stones or marbles. These can be found in the craft department of any store, and are the small decorative glass pieces added to clear vases. If afraid of going into the craft department, usually kids marbles can be purchased in the toy section, though these are becoming harder and harder to find.

Once the glass stones are added to the bottom of the hot pot, it needs to be filled with water and plugged in. Never plug in the pot while it is empty, since it does not have an on/off switch, and accidentally heating it on empty can cause it to melt, or possibly start a fire.

Add enough water to bring the water line about 3/4 of the way up the side of the unit, which allows room for some water to be displaced when the jar of glue is added.

Set the jar on top of the stones, and work it into a level position before letting it go. The bottom should be off of the heating element by at least the thickness of one of the stones, which will keep it from scorching. A thermometer should be added to the hide glue mixture, to monitor how hot it is getting as the hot pot begins to heat the water.

The thermometer can be any kitchen type thermometer, with a scale that can easily read 145 degrees without guessing too much on where exactly that measurement is. A digital thermometer would be more accurate to read, and can make it much easier if reading small numbers is a struggle.

Make sure to calibrate the thermometer when it is purchased, before using it on something as important as hide glue. That may sound

funny, but if the glue is made improperly, an entire instrument can fall apart, which makes the process far more important than it seems.

Fill a large glass with ice and then top it off with water. The idea is to get as much ice in the glass as possible, and fill the small gaps with water. Insert the thermometer into the glass fully, and allow it to sit for several minutes. The needle will slowly move itself towards 32 degrees, which is the freezing point of water.

After several minutes, look at the temperature reading, and it should be dead on 32 degrees. If not, rotate the dial of the thermometer until it is, and then insert it back into the ice and water again to double check. If after a few minutes the dial indicates the same temperature, the thermometer is calibrated, and ready for use.

There are several factors that will determine how fast it takes to liquefy the glue, as well as how high to turn the temperature on the hot pot. The general rule is to go slowly, because it is easier to control, and will decrease the chances of overheating.

Having more hide glue in the bottle will generally make the process of heating it take a little longer than having less, but as long as all of it is under the water line, it will still be a fairly quick process. On the Hot Pot, start with the temperature control around half way, and keep it there until the water becomes too hot to stick a finger in for more than a second. Back it off once the water becomes that hot, and give the glue some time to catch up.

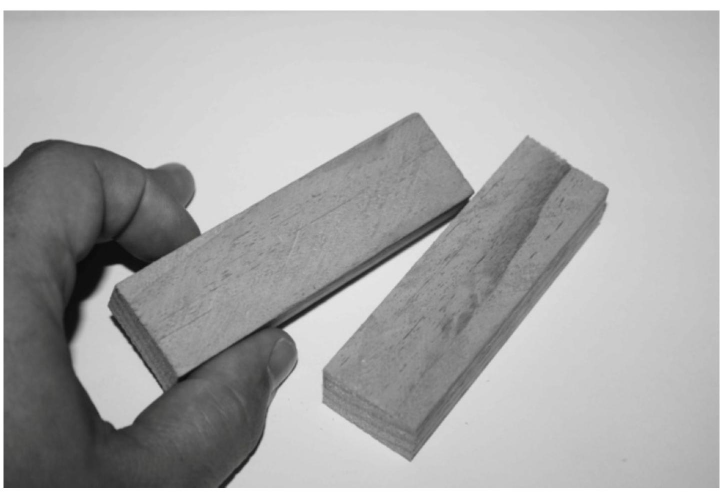
Since the glue is in an open container, it will take a little longer to heat. This is because there is something cold on top of the glue, and

something hot on the bottom. Closing the cover of the hot pot will help it heat faster. A taller jar may need a hole to be cut through the center of the lid, so that the jar can remain inside while the lid is closed around it.

Stir the glue from time to time to keep it mixed up, and to prevent the bottom from getting very hot, and the top from not getting hot at all. This will also encourage the general temperature to increase, because the hotter glue is being mixed with the cooler glue. Tip the jar sideways to get as much of the thermometer into the glue as possible when taking a temperature reading after stirring, and return the jar to upright before leaving it.

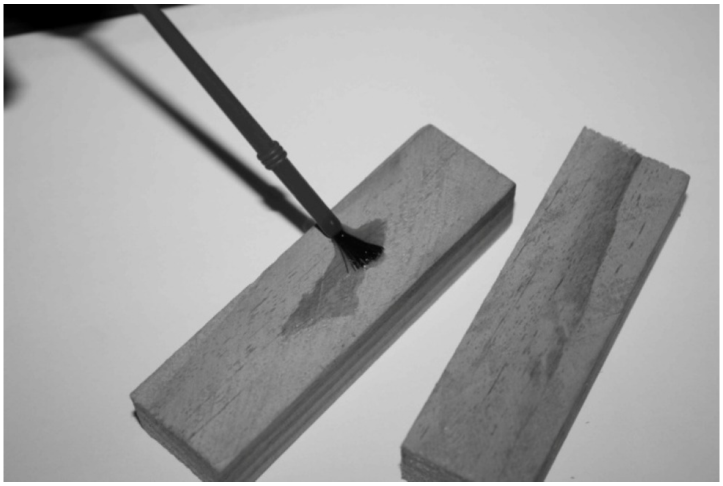
Once the glue has reached 145 degrees, it is ready to use, and should have the consistency of thin syrup, which falls off the brush in a continuous thin drizzle. At this point, the glue needs to be held at the same temperature, and not allowed to go up or down more than a few degrees. This is done by carefully watching the temperature on the dial, and getting to know the pot.

Only time and experience will tell how to regulate the pot temperature when it is needed to be kept at 145 for a long time. It is wise to do some tests on a day when the glue is not needed, and find out where the best setting is. If the glue is becoming too warm, simply remove it from the pot for a little while, and if it falls too low, simply turn up the temperature control.

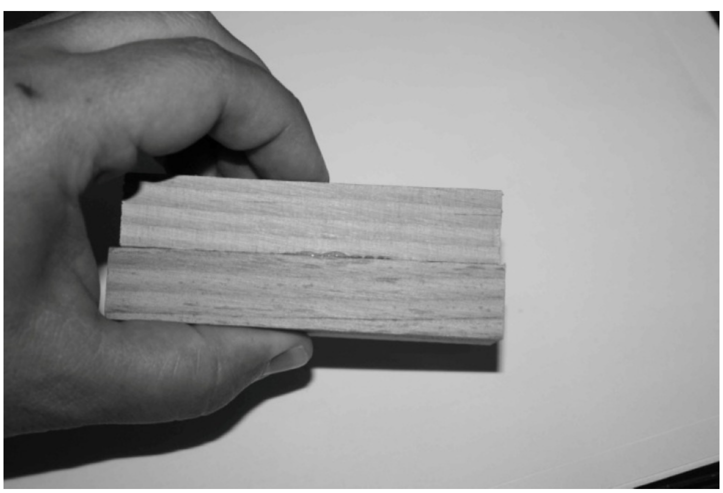


To use hide glue, it needs to be brushed on the surface of the wood, and then the wood needs to be clamped together, much like working

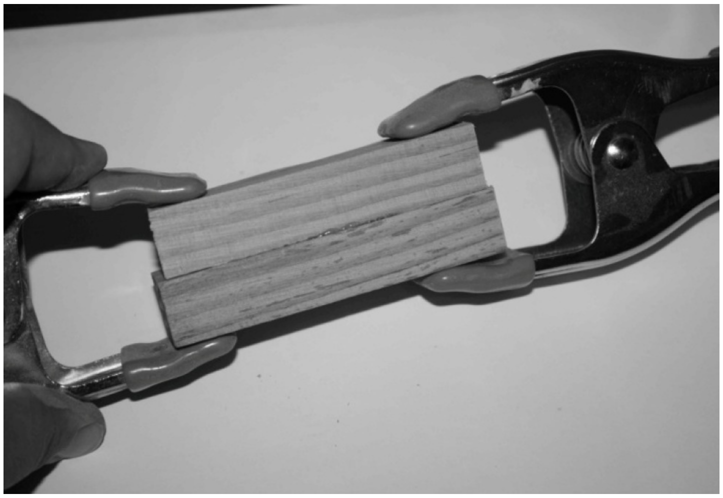
with any other glue. The difference with hide glue however is that there is a time component that must be observed as well. Once hide glue begins to cool, it gels and then loses its effectiveness. Work quickly with hide glue to make sure the glue is applied and the joint is clamped before the glue gels.



When applying the glue to the wood, use a natural bristle paint brush that does not have any metal on it, and quickly brush the glue onto one surface of the joint. In the picture above, there is only a small amount being applied to the piece, which just happens to be where the picture was taken. Before closing the joint, the entire surface is covered on the example boards.



With the entire surface quickly covered with glue, return the brush to the glue jar and start rubbing the two pieces together to spread out the glue. After a few seconds of rubbing, apply the clamps.



Hide glue has a very strong initial tack, but it should be left for several hours before stressing the joints. The glue itself will need to evaporate all the water off before the joint can be called full strength, which will take some time.

Hot hide glue is a very traditional wood working and instrument making adhesive, and has been used for many thousands of years with great success. There should be a feeling of connection between the instrument makers of the past and the old masters when using hide glue, as it was the same substance they used when making their masterpieces.

It may seem like an involved process, and to some extent it is more technical than using glue from a bottle. That being said, once the technique is mastered and the mew method gotten used to, it is just as easy and just as effective.

CHAPTER THREE

USEFUL TOOLS FOR GUITAR MAKERS

There are literally tens of thousands of dollars worth of tools that can be bought for instrument making, and even more for woodworking in general. There are however some tools that have much more value than others for guitar making. It would be nice to have the money to be able to buy a complete shop immediately, but since that is not the case there will have to be compromises made.

The tools that will be covered here are the small difference making tools which help make guitar building easier. Some of these are a little more expensive than others, however none are beyond the scope of an amateur guitar maker.

There are also older tools and specialty hand tools that will be covered, in an effort to reintroduce them to the new woodworker. One such tool that was initially a mystery to me is the cabinet scraper.

When I was first given a cabinet scraper, I had no idea how to burnish the edge to make the tool cut wood. So when I tried using it, to no surprise, it did not work at all. I tossed it into a deep dark drawer in the shop to die, believing that I foolishly bought some old archaic tool that was replaced by sandpaper years ago for good reason. I thought that if the old masters had sandpaper in their time, they surely would have used it.

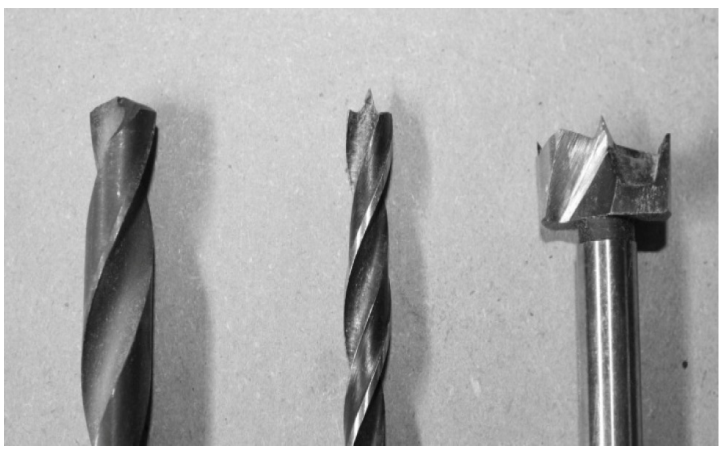
There it sat for a couple years until a friend of mine finally showed me how to put an edge on it, and it was love at first sight. Now the cabinet scraper is used more than sandpaper for leveling and truing a surface. It shows how simply knowing how to use something makes a difference, and how the old masters were right about how to smooth out their instruments.

The following pages will discuss the uses and importance of several tools, and how they each contribute to guitar making. It will be a good reference to come back to in the event that a few extra dollars become

available for a new tool. The abilities of each tool will be explained, so that any new tool purchase will be the best compliment to what is already possible with the current set of tools. It makes no sense to buy a tool for something that can already be done in the shop, so making good decisions about tools is about getting the most versatility from any new tool.

Finally, getting the right tool for the right job is as important as it gets. Using a brad point drill bit for inlays instead of a twist, is such a small thing, but anyone who has had a twist bit wander on them and ruin a fretboard can testify that it is a huge piece of knowledge. Many of the items that will be covered are only learned after the mistake is made, however they should be much more accessible after seeing them here.

In This Section We Will Cover:



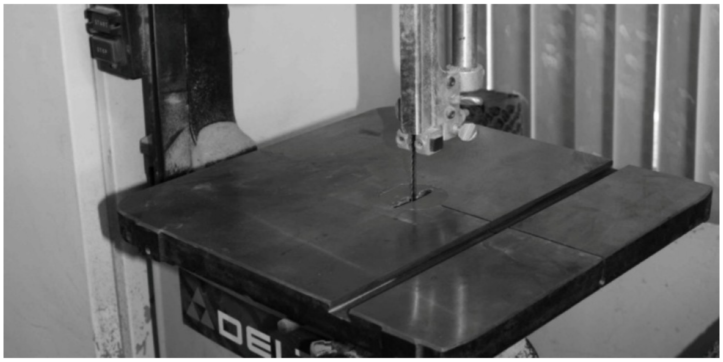
A few types of drill bits, and how they drill differently in wood. See here.

How to square, sharpen, and use cabinet scrapers for a very smooth finish. See here.

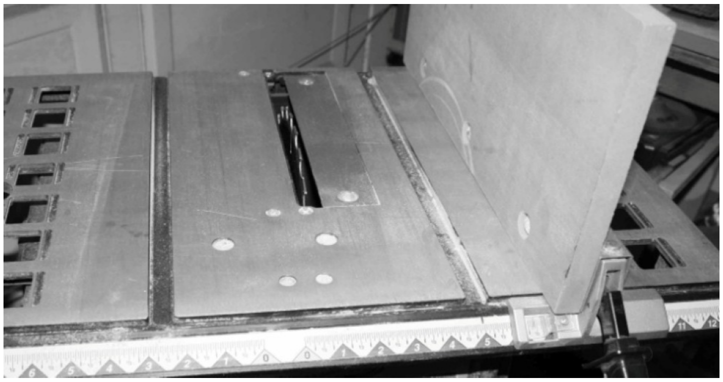
Using a Sureform to easily remove material while carving a guitar neck. See here.

How owning a thickness planer opens up more options for guitar making. See here.

See here.



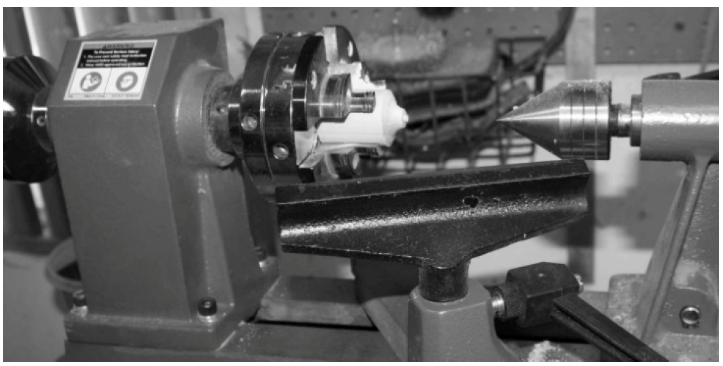
The band saw, and how versatile a single tool can be. See here.



The table saw, and how it can aid in cutting blanks for guitar making. See here.

The importance of having a router or a router table in the shop. See here.

A Dremel tool and how it can be used for a variety of tasks. See here.



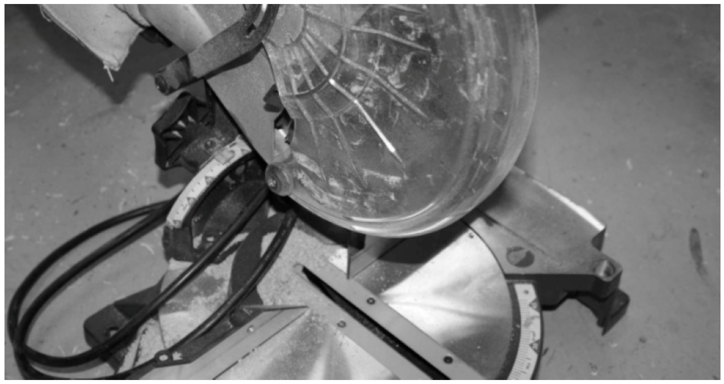
The lathe and how to use it to make tools for the guitar maker. See here.

Why owning a drill press in a great investment for guitar making. See here.

Several power sanders from large to small, and what they can do. See here.

The scroll saw and how it can be used for making templates. See here.

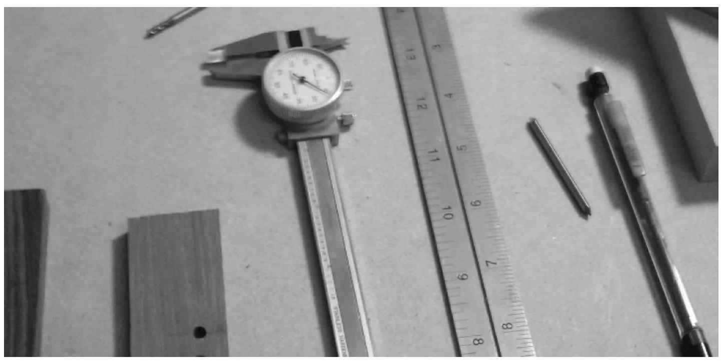
Using a jointer for many tasks around the shop, where smooth surfaces are needed. See here.



Miter saws, and the usefulness of being able to make angled cuts. See here.

The Beall Buffing System, and how to get an incredible shine from wood. See here.

A simple buff for the lathe or drill press, not requiring a separate motor. See here.



Tools are nice, but tools alone are not the answer for everything. See here.

Project Notes:

Though tools are an important part of the process, they are only one aspect. A shop needs to have tools, but the guitar maker also needs to know how to get everything they can out of each individual tool.

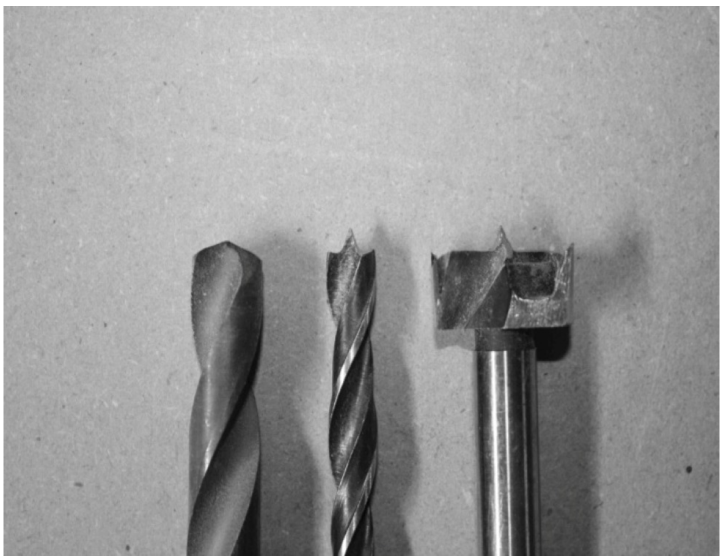
While it is worth the time and effort to save money and purchase new tools when they are needed, it also pays to know the full depth of what each and every tool can do. The router for example is the silent magician in the workshop, and can do almost anything any other tool can do. A router can be used as a jointer, a saw, a rotary tool, a jig saw, and in many other aspects. A whole series of books have been

written about how to make a router dance in the shop and do things that are truly amazing.

Read about the tools in this chapter, and think of ways to use the tools that are already in the shop to accomplish the same thing. If it is discovered that this is not possible, a new tool may be needed. However, once a small set of well known and reliable tools are owned, very few more will ever be needed. Remember, the master violin makers of years ago used a small selection of hand tools only, and they produced great instruments.

TYPES OF DRILL BITS

There are a few different kinds of drill bits out there for use in woodworking, and it is worth mentioning that some of them work better than others for guitar making. The three major types of drill bits that are commonly seen in a wood shop are twist bits, brad point bits, and Forstner bits. Each of them have their advantages, but it is worth knowing how they work and how they make holes in wood.



The picture above shows three different ways to make a hole in wood. The bit on the left is a twist point drill bit. They come in assorted sizes, and are the standard type often seen in large sets with many bits. The cutting action is at the head, and is very large when compared to other drill bits, which can sometimes lead to problems, as will be discussed.

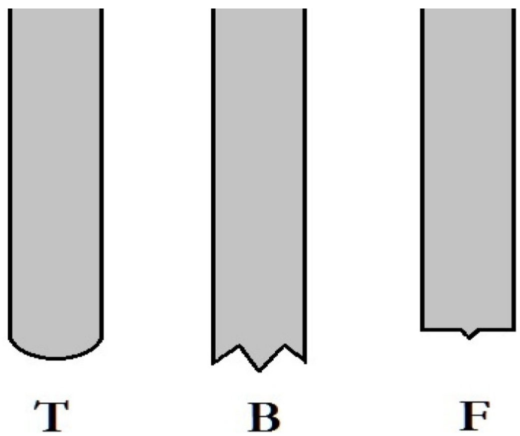
In the center is the brad point drill bit, which is designed a little differently. It has a point in the center that contacts the wood first, giving it a direction to travel in before the cutters on the side remove the bulk of the wood. They leave straight sides, and clear wood shavings well.

The large bit on the right is called a Forstner bit, and these come in sizes starting at 1/4" and going up to 4" and sometimes larger. These bits also have a center point that pilots the bit, and they leave nice straight sides

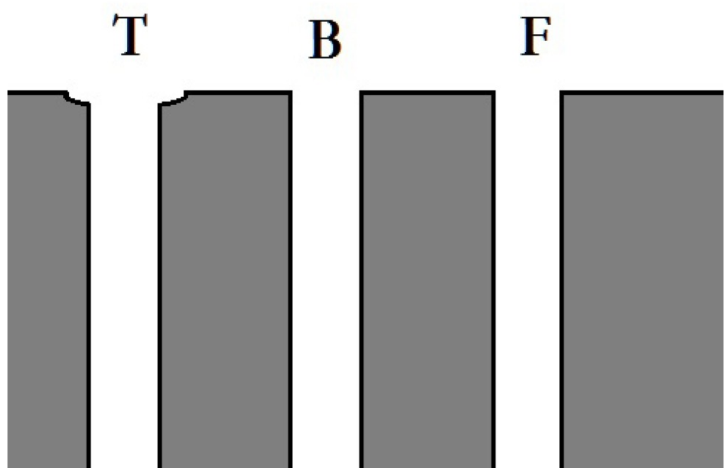
on the hole being drilled. These bits are useful any time a shallow hole with straight sides is needed, such as in round inlays on a fret board.

A paddle bit or spade bit does the same thing as the Forstner bit, however it has a very long pilot point, which makes it next to useless for luthiers.

There are many other types of specialty bits and large construction quality auger bits as well, however these are rarely if ever used in making a guitar.



The diagram above shows three profiles that are associated with each bit. This is the shape of hole they leave behind when used. The twist bit on the left leaves a hole with a rounded bottom, which is sometimes steeper or shallower. The brad point bit leaves a ring of taller wood around the center brad, which is shown in the middle. The hole on the right is for the Forstner bit, which leaves a small dimple at the bottom center of the hole and nothing more.



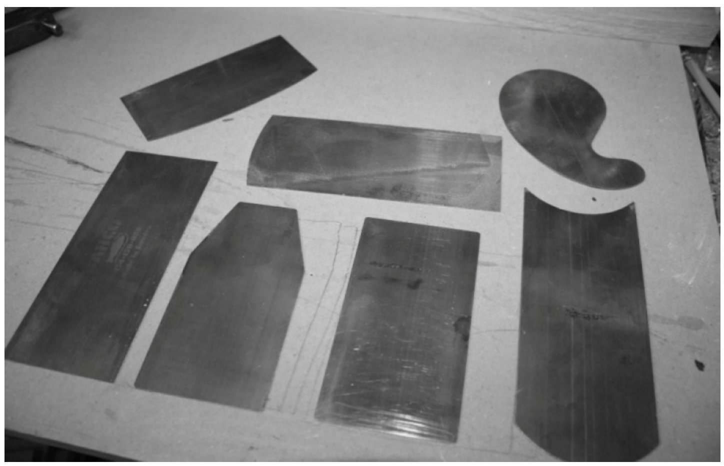
A drill is a very lazy tool, meaning that it will go in whatever direction is of the least resistance. The twist bit will have a tendency, especially with larger bits, to wander around before digging into a straight path. This is seen in the hole profile on the left, where the top has had a wider diameter of wood removed than the desired hole diameter. They can also catch, and tear out large chunks of material.

The brad point bit in the middle, and the Forstner on the right leave straight holes without any wandering, because each of them has a pilot built into the bit that helps keep it going straight.

For all guitar making duties including inlays, it is best to use a brad point or Forstner style bit because they drill straighter and go where they are placed.

USING A CABINET SCRAPER

A scraper blade, or cabinet scraper is a very useful tool to have in the shop. They are thin pieces of metal that come in mostly rectangular shapes, though there are curved ones as well. A tool called a burnisher is used to draw out a small burr that becomes a fine cutting edge. This cutting edge is drawn across the wood, slicing through the fibers in much the same way a plane works.

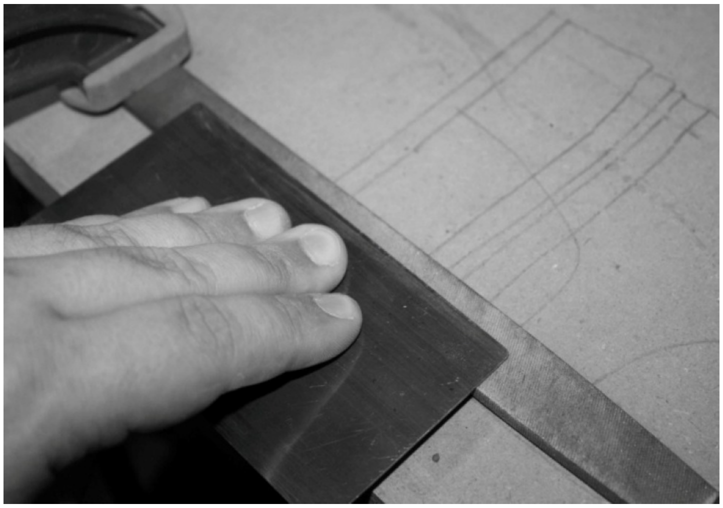


There are several advantages to using the cabinet scraper over sandpaper, the most significant of which is the fact that the cabinet scraper is a cutting tool. Sandpaper is a very messy way of smoothing out a piece of wood. It is essentially a grinding method, where small rocks are used to grind the surface until it becomes even. On the microscopic level, this literally destroys the fibers of the wood, and pushes microscopic dust into the pores of the wood, which obscures the grain in figured pieces especially. Cutting tools remove solid slices like a hand plane does, which is a much cleaner method of wood removal.

Another advantage to using the scraper over sandpaper, is that there is no need to work the same area several times. Sandpaper requires several grits of paper to be used, each one getting finer and finer until a nice smooth surface is created. The same surface is worked on several times with this method, which is a ton of extra work. The scraper leaves a very smooth surface that would compare to 400 grit sandpaper in smoothness or finer. A well squared and sharpened scraper blade will leave a final surface that requires no further preparation before finishing.

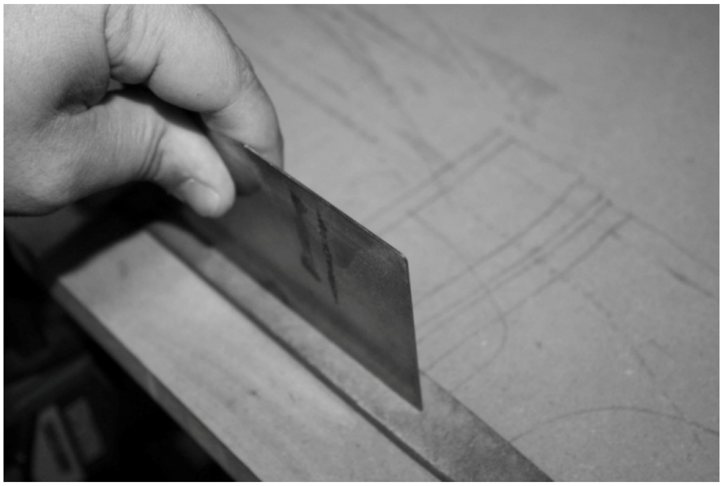
Lastly, an advantage to the cabinet scraper is the fact that the edges are flat. This means that when scraping areas like bindings on the guitar, it will tend to leave a flat surface behind. A scraper can be used without much of a bend in it, and it will level out a surface to the same height very quickly. The flat edge tends to find the higher spots and remove wood from them first.

Finally, a scraper blade has one last hidden advantage over sandpaper. It does not run out like an old piece of sandpaper. The scraper will lose some metal along the edge from squaring and sharpening, however this will take years and years to lose enough metal that it has to be replaced. It will more than likely be lost or lent to someone before it needs to be replaced due to wear. Sandpaper on the other hand has to be replaced often, and it is not cheap. Good sandpaper is one of the most expensive disposable items used while making guitars.



The first thing that has to be done with a new scraper is to square up the edge. Place the scraper on a fine metal file that has been clamped to the bench to keep it from moving. Making sure to keep the long edge flat against the file, move the scraper side to side to true the flat face. Flip the scraper over and do the other side the same way. This will help in the end when a burr is drawn off, because it will be more even if it comes from an even surface to begin with.

The important thing is not to press to hard or try to remove too much material. This process is just to remove the old burr and even up the edges.

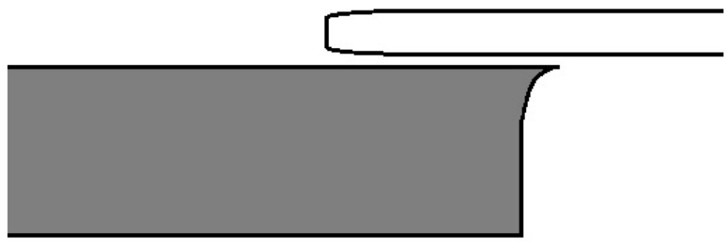


The next step is to turn the scraper up 90 degrees to the file, and true the thin edge. This again is not very aggressive, and only requires a few strokes back and forth to clean up. After the edge has been filed, a light touch on the sides again like in the first step will complete the squaring of the scraper blade.

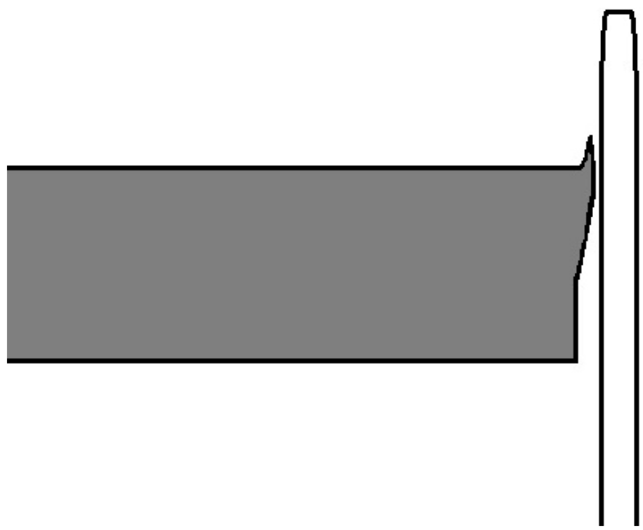
With the end square and the faces square from the file, this is what the edge would look like under magnification. It will be very hard to see this with the naked eye while working in the shop, so keeping the scraper vertical while filing it is very important. A lopsided scraper will not have a very good edge for scraping wood.

The only tool needed to make the burr, which is the extremely small knife like edge on the scraper blade is called a burnisher. This can be as simple as any piece of hardened steel that is smooth and polished, such as the smooth part of a chisel near the handle. It can also be fairly elaborate, like the bottom picture on the left. This is a specialty made burnisher from Stewart McDonald, which has been sharpening scrapers for close to a decade now. Veritas also makes an excellent burnisher that fits in the hand,

and is drawn across to create the fine cutting edge. If scraper blades are going to be used a lot, it is definitely worth purchasing a good burnisher.



The way a scraper is burnished is shown in the above and below diagrams. The edge of the scraper is being shown in gray, and the burnishing rod in white. The scraper is laid flat on the bench and the burnisher is pressed hard onto the surface, parallel to the scraper. It is drawn across from end to end a few times, which causes a small amount of steel to move forward. This is the burr that will eventually do the cutting.



The burnisher is then rotated almost vertically and ran across the edge from end to end again. This turns the burr so it points up rather than forward. The thumb can be ran across the edge of the card perpendicular to the burr, never running along it, and the edge can be felt. This is much the same way that a pocket knife is checked for sharpness. Moving the thumb with the edge will also show that the blade is sharp, though it will do so by slicing the thumb open, which is not advised.

This is what the motion of the first part of burnishing looks like. The piece of tool steel is laid flat against the scraper and pressed hard while being drawn in the direction of the arrow. It is important to go from end to end completely, and not miss any areas along the edge. Rocking the burnisher a little to where it is not completely flat against the face of the scraper is ok because it will help direct the force of the steel into the area near the edge. However, do not rock more than a degree or two because it will be hard to turn the burr up in the second step.

The second step of burnishing is shown here, with the purpose made burnisher. The rod is held in the unit so it will contact the edge of the scraper at an angle, to roll the burr upwards towards the face. The rod looks

like the diagram on the bottom of the previous page, and it turns the burr up so it is facing in a direction that is more useful to cut with.

To use the scraper, grasp it as shown in the picture above with both hands. The burr that was created earlier is on the bottom edge, facing away from this point of view. Angle the scraper slightly forward, and use the thumbs to put a small outward bend into place. With the scraper positioned like this, push it across the wood a few times. Adjust the angle at which the scraper is pushed across the wood, until the most effective cutting angle is found. This will vary a little bit depending on the angle of the burr put on the scraper. Though with a little practice, finding the sweet spot will be easy.

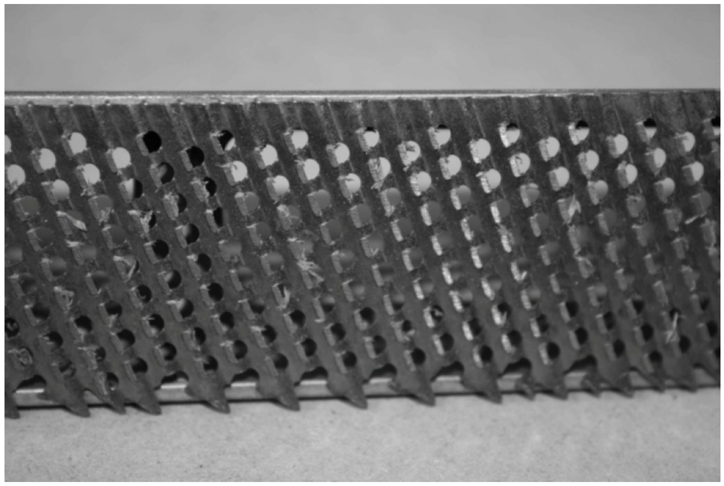
Pushing the scraper can get tiring, so for a change of muscle groups, the scraper can also be pulled. In this method the edge is facing the body and the bend is made towards the body as well. The angle is the same as while pushing, and when drawn across the wood it will make miniature plane shavings. These can be seen in the second picture at the start of this section.

Once the scraper feels like it does not have the same grab as it used to, and is not cutting as well, it will need to be burnished again. Repeat the two step process with the hardened steel to draw out and turn up a new edge. Only once in a while will the scraper need to be filed and squared, so burnish several times before filing.

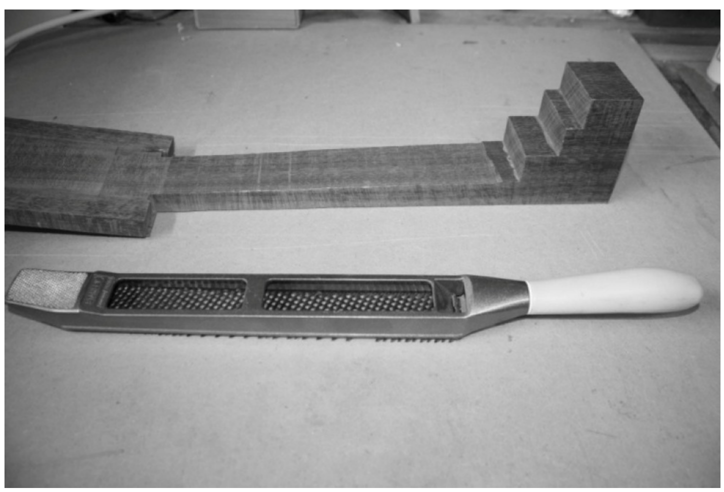
THE SUREFORM

When carving the neck of the acoustic guitar, or any guitar, a very efficient and easy way of removing the bulk is to use a Sureform. This tool is essentially a large cheese grater for wood, and removes material with very little effort. The tools come in several shapes, but the long tool with a handle at one end is the easiest to use for guitar making.

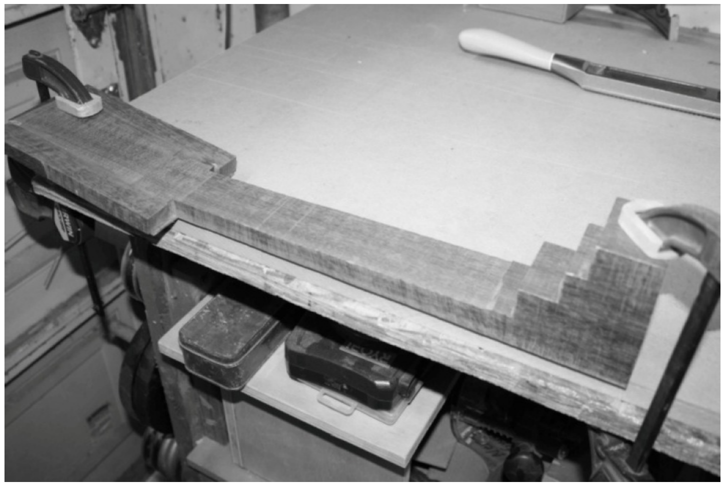
The Sureform that is best for neck work is around 12" long and about 1-1/2" wide. There will be a handle on one side, and an area on the other where a second hand can rest while using the tool. The cutting screens are replaceable should they wear out, which will take a very long time. Even on this tool, which has been in the shop for several years, there are only a few teeth missing, which is hardly enough reason to replace the screen.



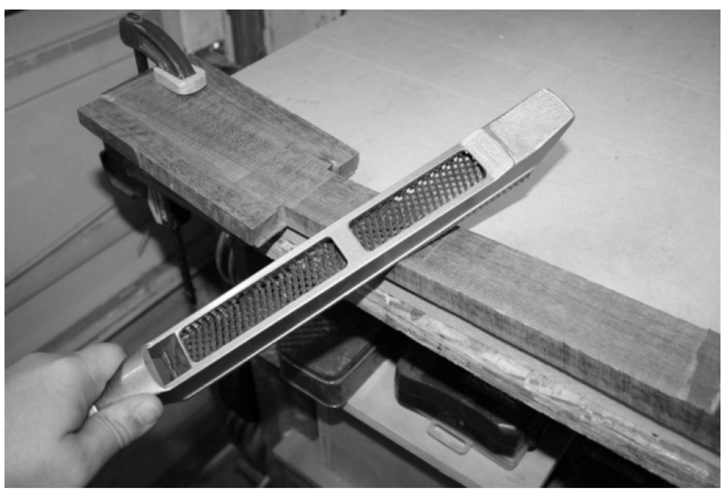
Here is a close up view of the cutting area of the tool, and several small teeth can be seen. Each one of these is very sharp, and the holes behind the cutting edges allow for the carving dust to fall through and not get stuck. This feature alone greatly increases the efficiency of the tool, making it cut longer without clogging.



To use the Sureform, select a neck that is ready to have the profile carved.



Clamp the far ends of the piece to the workbench using bar clamps, being careful not to apply too much pressure at the headstock area. The edge of the neck should overhang the edge of the bench by about 1/4" to allow room for the tool to work.



Hold the Sureform as seen in the picture above, and also place another hand on the right side where the flat area is. Holding the tool at a slight angle, draw it across the edge of the neck, removing material as it passes. Over time, it will become easier to see what angle and how much pressure are needed to remove material the most efficiently, which will only take a couple sessions to figure out.

Concentrating in one area for about 30 seconds, this was the amount of wood that was removed from the edge of the neck. It may not look like much in the picture, but it was a lot more than any other method in real life, especially for only 30 seconds.

The vast majority of the waste wood removal can be done with the Sureform before switching to a file, and finally scrapers or sandpaper. The majority of the wood will be removed by the Sureform, making the later steps in the process much easier and less frustrating.

The angle at which the tool is used to attack the neck can be altered in order to carve different places and different curvatures. When the edge of the neck needs to be carved, tipping the tool upwards so it is closer to vertical will focus the removal into that one area. Be careful as the wood

is removed because it will be taken very quickly, and once it is gone, it can never be put back.

Likewise, changing the angle of the Sureform to be more flattened can increase the amount of wood affected by the cutting edges, and help make a more gradual curve. Whatever area needs to be carved, simply tip the tool to the proper angle to catch that area, and the tool will do the rest.

These can be found in almost any hardware store, and of course online. There are several types available, and if this one works well there is no reason not to try the others. The only real difference between any of

them is the size of the cutting area, which is all made from the same kind of wire mesh material.

When carving the neck, completely finish one side with the Sureform, bringing the neck as close to final dimensions as possible, but leaving a little room for final sanding or scraping. Once that has been completed, flip the neck around and carve the other side to match. Watch carefully as the carving process goes on, making sure that there is not too much wood being removed, and that the two sides are coming along evenly.

Once the second side is complete, begin working out the Sureform marks with a round or flat file, reducing any high spots and removing any deep gouges. Once the file work is done, a cabinet scraper or sandpaper will finish out the smoothing.

THE THICKNESS PLANER

Of all the tools in the shop, one of the most underestimated is the thickness planer. This tool has so many uses that it really should be in every guitar shop. The planer allows the guitar maker to quickly and easily thickness their own blanks, which saves money and time. Also the planer can make perfectly flat surfaces with ease, meaning wood is easier to glue together. Once a basic set of tools are obtained, a thickness planer should be the next purchase.

For guitar making, the planer does not have to be anything special, it just has to work. The prime example is the planer in the picture above. This is an inexpensive Ryobi planer from a home improvement store, costing less than $200. This planer has been in service for almost a decade, the blades have never been changed, and it has never once done anything but work.

When looking for a planer, there are a couple things to pay attention to. The unit will be sized according to the width of the blades, meaning how wide a piece can be planed with it. It would make sense to think that a 16" dreadnought will need at least that wide of a planer, however this is not the case. If the pieces are planed to thickness before they are joined, they can be sent through one at a time.

As long as the planer being purchased is a 12" or 10" wide unit, it will have no problem thinning the plates for the guitar. Before gluing the pieces together into one large plate, send them through the planer to bring them down to thickness. Send each piece one at a time through the unit, and do not adjust the machine to remove more wood until both pieces have been passed through. Once they have, unlock the head, lower the cutter a tiny fraction, lock it, and send both pieces through one at a time again. Repeat this procedure until both halves are the thickness they need to be, and then they can be glued together.

A good thickness for tops is anywhere between 0.110" and 0.085", which will make a light and responsive top at the thinner ends of this scale. For backs, they can come in around 1/8", leaning on the thicker side.

Arguably, the planers most useful feature is that it can make perfectly flat surfaces very efficiently and easily. This is important for several reasons, the first one being when gluing pieces together.

When a piece of wood is glued to another piece of wood, the surfaces must be completely flat otherwise gaps will appear in the wood, and the joint will not be as strong as it could be. The planer can put a flat face on both sides of a board in a couple quick passes, and it can easily be glued to another board. If this were to be done by hand with a plane and scrapers, it would take an expert a long time, let alone someone who is a beginner.

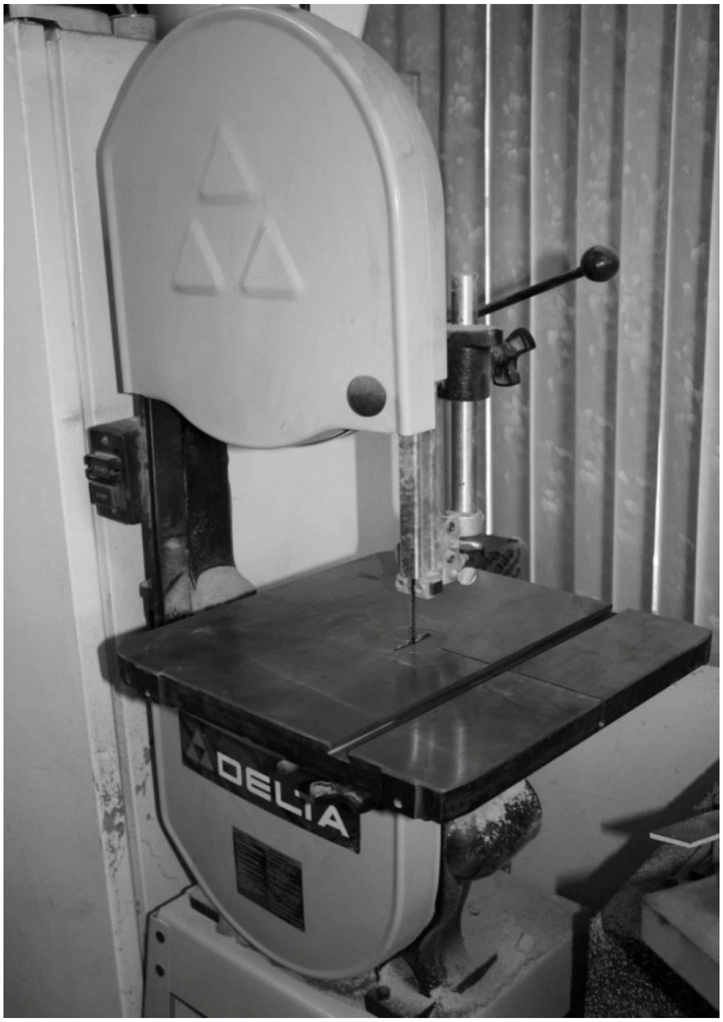
Finally, necks that are made in the shop need to be completely flat in order to work properly, and the planer can take wood that might have a bulge or dip, and flatten it out.

The secret to making a great guitar neck is to use materials that are dead flat in all stages of the process. Before gluing up a stacked neck, the blank is ran through the planer, taking off a tiny fraction from both sides. This small wood removal leaves both sides completely flat, and ready to be made into a neck.

The fretboard is ran through the planer as well before being glued to the neck for the same reason. It is far better to start out with completely flat wood when making a neck, than to have to work on sanding it all level later in the build.

A thickness planer should be a top priority to get into the shop if not in there already. It will make thinning wood easier, faster, and more accurate. Plus, it will take much of the hassle out of making a nice and straight neck. Fretting will be easier, actions will be lower, and in the end the guitars will play better.

THE BAND SAW



An absolute shop favorite for almost any kind of cutting is by far the band saw. This very efficient tool can come in many sizes, from smaller table top models to very large floor standing machines. The saw in this picture is in the middle, with 14" wheels and a small base that raises it off the floor.

Band saws operate using a continuous blade that is shaped like a large metal loop, with teeth on one side. The loop is placed on the wheels and then they are tightened, putting tension on the blade. The wheels spin

with the help of a motor, and the blade moves continuously in one direction. Material is fed into this moving blade, which can be used to cut straight lines as well as curved.

Band saw blades come in several different sizes and types, which cover practically anything that could ever need to be cut. There are special blades for cutting metal, plastics, and abrasive belts that act like really long belt sanders. These can all be interchanged as needed, and storage of the other blades is as simple as putting a nail in the wall and hanging them.

The band saw is useful for a number of cutting operations when making the guitar, and a few of these are extremely helpful. A band saw with a riser block to allow for a taller depth of cut, can be used to split open wide boards into back and side blanks for the guitar. A saw with a maximum cut height of at least 8-1/2" will be perfect for almost all acoustic guitar backs, assuming they have a 16" lower bout.

The band saw is an excellent tool for making the preliminary shaping cuts on the neck, and cutting it out of the stacked blank. Running the unit through the band saw takes much of the time and sweat out of the process of carving off the majority of waste wood from a neck, and does a very clean job of it.

The table can be tilted on an angle and used to rip 30 degree beveled strips off the edge of a long board, which can be used to make blanks for kerfing strips. These strips can be run through again with the table flat in order to thin them a little, and then a kerfing jig can be used on the saw to make all the cuts which allow the piece to flex.

Sawing out the rough shape of the plates is very simple on the band saw, and a thinner blade works really well at making easy curves and following the lines. The guitar top is far easier to work with once the bulky corners as well as other waste wood have been removed, and the band saw makes this process very easy.

Cutting out head and tail blocks from a single flat piece is something the band saw can be used for, and the tilting table can help bevel the two edges that do not touch the plates, in order to reduce the weight at the shoulders.

If individual braces are being sawn from blanks, set up a fence that is a certain distance from the blade, and run the piece through to rip off several bracing blanks.

Even a smaller band saw that sits on the bench top can be a very important and powerful asset to the shop. These tend to have enough of a throat and depth of cut to handle everything except splitting large pieces of wood. Before switching to the larger Delta in the pictures, the main saw was a bench top model, and it was a great saw for several years.

The best thing that can be done when purchasing a saw is to throw the blade that comes with it in the trash, and spend a few dollars on a nicer blade. It will cut better, last longer, and make the saw perform much better than before. When selling the saw, the manufacturers typically give out the cheapest blade they can, or they give nothing. Spend some money on a nice blade, and the band saw will become a favorite tool very fast. There is a reason that some band saw blades are more expensive than others, and it is because they are better. Even an inexpensive saw can be a great tool simply by replacing the stock blade with a higher end after market blade.

THE TABLE SAW

A classic woodworking tool, the table saw has many applications for which it can be used in guitar making. Table saws can come in many sizes, though a small one like in the picture above is perfectly fine for any guitar making needs. Table saws can take different blades for different cuts, however they all tend to do about the same thing when it comes to cutting wood.

A table saw is a flat metal table top, with a blade that comes out from the center of the tool, and can be raised and lowered to change the depth of cut when needed. The blade can also be tilted on most models, which allows for all kinds of beveled cuts. A form of measuring and limiting the cut called a fence clamps onto the table top, and is used to make accurate cuts over the entire length of the board.

The miter gauge can be used in the small tracks on the top, and is useful for making angled cuts or cross cutting pieces into smaller lengths. Miter gauges also give the hands a place to hold onto that is not as close to the blade, making the cuts safer.

For guitar making purposes, the table saw can be the answer to not having a method of splitting thick pieces of wood into thinner pieces for making backs and sides. If a band saw with a riser block is not available, a

table saw can be used as described in chapter one, to re-saw any piece of wood that can be found in a hardwood store.

When making other blanks, the table saw is also very efficient at cutting through larger pieces, allowing the use of more exotic and often times harder pieces of wood. Fretboards, stacked necks, laminated necks, end blocks, and bridges can all have their blanks cut with the table saw.

During neck construction, the scarf joint often terrifies people because it is difficult sometimes to get the two faces to meet nicely. This is often the case when the sawing was done poorly, resulting in a cut that looks like a mile of bad road. A jig can be made for the table saw that makes short work of cutting a very clean scarf joint, virtually eliminating the planing and sanding process afterwards.

Kerfing blanks can be made on the table saw simply by tilting the blade in one direction to the desired angle, and ripping off several strips. A very fine blade and a jig can be used to saw the small notches all along the strip as well, eliminating the need to buy expensive kerfing strips.

A very fine finishing blade can be purchased and installed on the saw, which will make extremely smooth cuts, even through thinner material. This is perfect for making binding strips, and can even be used for making purfling. Binding strips can be ripped off the edge of a long board, and bent and glued onto the guitar edges. Veneer sandwiches can be pressed and glued, and then cut into thin strips on the table saw. This opens up many more possibilities than simply black/white/black for purfling.

Bracing can be ripped from a blank using the fence, which can be set to a precise width, making all the bracing pieces completely uniform. Then, the miter gauge can be used to cut the pieces to length for gluing to the guitar top.

For many guitar making needs, a smaller table saw that sits on the bench top will work perfectly fine, provided it has at least an 8" blade. The larger floor standing table saws are very nice to have, but they are really not needed for guitar making.

The small saw that is shown in the pictures here and throughout the book has been in service for over a decade, and it has done nothing except exactly what has been asked of it. The original blade is still in the shop, and is used for ripping rough stock, and a finer blade is used for more delicate work. The blades are easy to change, and the set of legs beneath it allow it to be moved around the shop very easily.

THE ROUTER AND ROUTER TABLE

The router will be one of the most often used tools in the shop, especially if it is pressed into service for non-traditional tasks like jointing and tapering. A good router will make many operations easier, faster, and more accurate than doing the same job by hand.

A router is essentially a motor that rotates a cutter, and is built into a housing that can be held in the hands. There is a plate on the bottom that is rested on the surface of the piece being cut, and a couple handles to control the tool while using it. The bit spins at an incredibly high speed, and when it makes contact with wood, the material is removed easily.

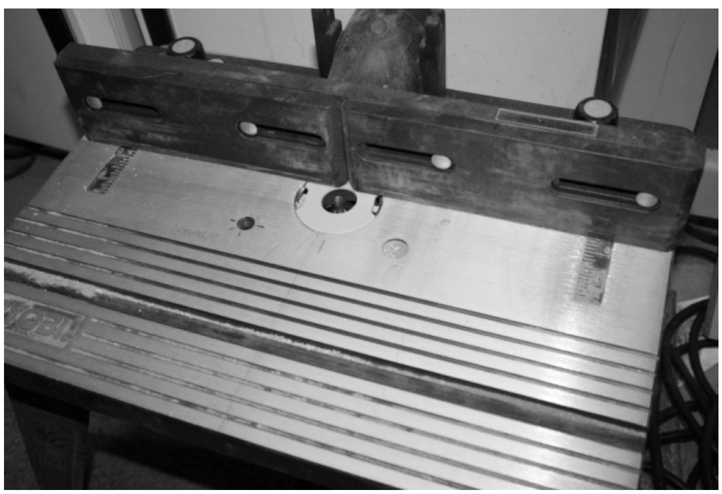
These tools come in many different variations, though all of them are essentially the same thing. Some routers will be larger than others, and are used for very heavy duty work, while others are very small, sometimes called laminate trimmers. The smaller ones are great for routing binding channels, and a regular sized router can do the binding as well as anything else that guitar making requires.

When looking for a router, find one that is made solidly by asking at a fine woodworking store, and also look for one that is in the medium size range. The bulky large routers are great for doing very heavy and tough work, but that is never really going to be needed when making guitars. A very small laminate trimmer will work for a long time, however

sometimes a little more to hold on to is desired, which will lead to a standard sized router being purchased anyway.

The collets on a router are typically 1/4" or 1/2" in the United States, and there are several models that can accept both sizes by simply switching the collet that is on the machine. It is a good idea when in doubt to first look for a machine that does both, and if not, get a half inch unit and an adapter that will change the collet size to 1/4" when needed. This way, any router bit can be used regardless of shank size.

Even an older router can be made to work very well, and will be an excellent addition to the woodworking shop. Before the router on the left was purchased, the only router in use was a Black and Decker 5/8 hp that is older than I am. However, it worked well, and was used for a decade before purchasing a new one. The older router runs fine, and is still used for certain tasks.



Consider looking at a small router table as a companion purchase to the router, or make one from heavy plywood or MDF. A router table frees up both hands, since the table will be holding the router in place. This is a safer way of using the router, and with the fence and miter gauge it is also more accurate.

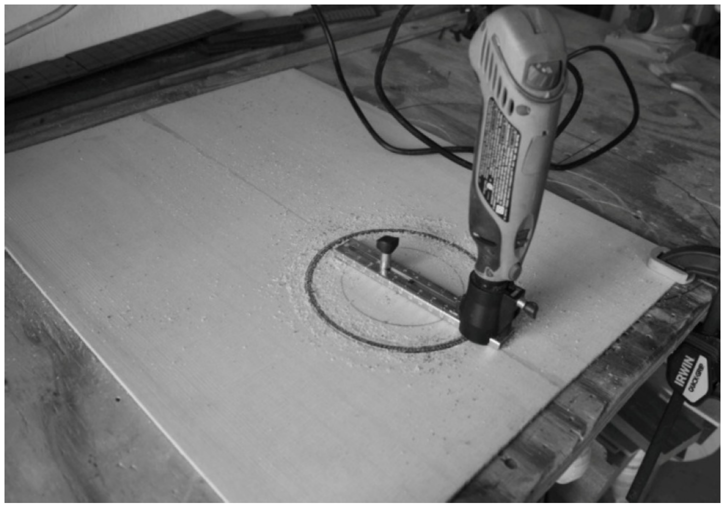
Routers can be used for many things in the shop, and it seems like once they are used for a few things, more projects will pop up that the router is perfect for. A router can be used to create inlay cavities, make truss rod slots, trim plate overhang, taper fretboards, trim headstock veneer, inlay back stripes, and route binding ledges.

The router can be used with a flush cutting bit and perform well as a jointer, which will make book matching pieces for tops and backs much easier. As an inlay carving tool, the router cannot be matched by the rotary tool when it comes to power and the extra mass that keeps the bit from pulling.

A router and table are great for following a single piece with a template bit, and making copies of an existing shape. The perfect example is when making a guitar mold. One piece needs to be made by hand, and the rest can be made by copying the original on the router table. This helps make better molds, which in the end will make better guitars, because they are more accurate.

A well functioning router will be a very important part of the guitar making tool set for a very long time. It is worth every square inch of shop space it takes up, and will help make better guitars.

THE DREMEL TOOL



Though actually called a rotary tool, the Dremel company has essentially changed the language and claimed the rotary tool as their own. The Dremel tool is a handheld power tool with a spinning head that can accept many different kinds of bits. It has a much smaller collet than the router, normally 1/8", and accepts correspondingly smaller bits.

Many companies make a rotary tool, though few make as many accessories and bit types as Dremel does. This becomes an advantage when doing more than simply carving or cutting, as will be explained shortly.

The tool itself is very simple, can be easily held in the hand, has a speed selector where the rotation of the bit can be increased or decreased, and a small collet that is easy to open and close with a wrench. The nicer tools will allow for many accessories that are useful to guitar making, and they will screw onto the end of the tool housing, making a more versatile tool.

A small router base can be purchased for the Dremel tool which will turn it into a precision router, capable of getting into very tight places depending on the bit being used. The light weight frame does not have the mass to prevent the unit from being dragged, however typically the cavities are so shallow that it is not an issue. Many inlay artists use a similar setup

when inlaying massive and intricate inlay patterns on their guitars and fretboards.

There is a circle cutting accessory that can be purchased for the Dremel as well, and it is pictured at the top of this column. The advantage to having a circle cutter is that the tool can now be used for inlaying rosettes and cutting out the soundhole. If several rings of purfling are going to be inlaid as the rosette, the circle cutter makes it easy to carve out precisely fitting cavities that the binding strips can be glued into. The diameter of the bit will determine the width of the slot being cut, which means that every time the Dremel is used with the circle cutting jig, the slots will always be the exact size for a gap free inlay.

The picture above shows this process as it is being done to a mahogany top. The circle cutting jig can be set to a certain diameter, and will always cut in the same place as it is rotated around the center pivot point. The channels are a perfect width for inlaying purfling, and the results are seamless.

Dremel tools also have other accessories that are helpful, ranging from a flexible shaft that attaches to the tool, to a number of different bits that can be used. The flexible shaft allows closer access with the spinning head in order to reach tight spots that the body of the Dremel would otherwise prevent. An example would be when buffing the frets.

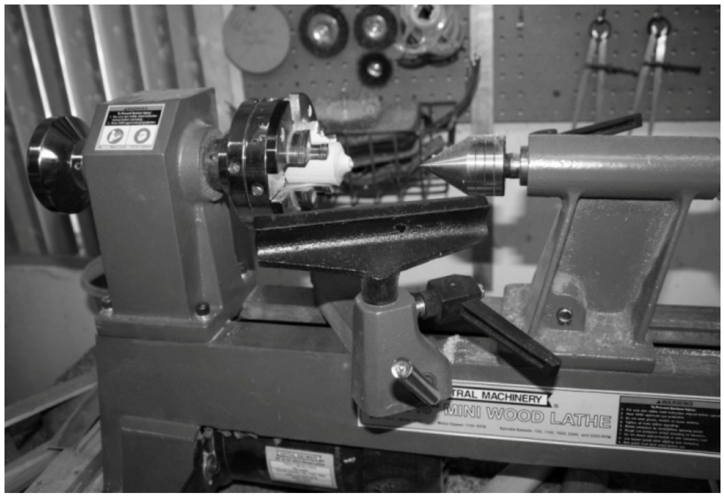
The range of bits that the tool will accept seems only limited by the imagination of the people who create them. There are a number of bits that are useful to the guitar maker, as well as some that are a little different.

Several small cutting bits are important to have when doing inlay work, and they make the process much easier. These are called spiral cutting bits, and they remove wood very well, and leave little in the line of fuzz or burr. The down cutting type is the best to use because the cuts shear downwards, eliminating fuzz completely.

There are small buffing wheels available that can be used with polishing compounds to put a mirror finish on the frets after they are leveled and recrowned. The small cotton buffing wheels polish a fret completely in a few seconds, and leave it looking like brand new. When putting the final touches on the instrument, a set of gleaming frets is a really attractive way to hand over a custom guitar.

Having a Dremel tool is very helpful around the shop, and will make many operations much easier to perform. Try getting the Dremel brand, though any tool will work well if practiced with and cared for.

THE LATHE



Absolutely nothing that is found on the guitar with the exception of the bridge pins, end pin, and knobs for electric guitars can be made on the lathe. It is a borderline useless tool when it comes to making guitar parts, but where it shines is in making tools.

Lathes come in various sizes, from very small pen making lathes to very large lathes typically used in metal working. For the guitar maker, and more so the tool maker, having a midi lathe is perfect because it is large enough for whatever small jobs would be needed, and it is small enough that it does not take up too much space in the shop.

Lathes are measured in two ways, one called the swing and the other called the distance between centers. The swing refers to the distance from the bed to the center of the headstock, which grips and rotates the piece of wood being carved. The distance between centers refers to the maximum length that the lathe will open up to. This is measured from the headstock to the tailstock.

The headstock is where the rotation happens, and also where chucks, faceplates, and drive centers are attached. These grip the piece of wood being shaped on the one side, and the tailstock supports the other end. The mechanism in the tailstock is typically a live center, which is a sharp

center point on a set of bearings that rotate and stabilize the piece without adding any resistance.

If building tools for guitar making is the purpose for having a lathe, it is absolutely a requirement that a chuck also be purchased. These are commonly available through pen making retailers online, and they have an extensive collection. A four jaw chuck where all the jaws move together is perfect for making tools, and will be used to hold all kinds of pieces while the lathe tools shape them. Purchase a medium sized chuck, which will be great for any and all guitar making needs, as well as be able to hold onto almost anything that may need it. Essentially the chuck is the most important part of the lathe, and without it making tools is much harder.

A good woodworking lathe for the guitar maker and tool maker needs to be of average size, meaning something near a 6" swing, and a distance between centers of around 18". This will be plenty big for making most projects, and will also be large enough to make lathe tool handles as well if needed.

As far as guitar related items go, the lathe can be used to make custom turned knobs for electric guitars and basses from any type of wood that is desired. Blanks can be glued up, chucked onto the lathe, and several can be turned very easily. These add a custom touch to the guitar, and they are a nice break from the standard knobs that are seen everywhere.

For making tools, the lathe is an excellent machine that will end up being used for more and more things as it becomes a part of the shop.

Tool handles are the most common thing to be made with the lathe, and can save several dollars each time one is made. Often times files and other hand tools do not come with handles, which is a rip off in my opinion. Tell the man where to stick it by making the handles on the lathe rather than buying them, and the tools will look much better anyway.

Handles for spool clamps, round clamping cauls, and tool handles can all be made on the midi lathe. Rosettes can be glued to a face place and trimmed to size while rotating on the lathe, eliminating the need for a circle cutting jig on the drill press.

Large carving mallets can be turned from a piece that is glued together, and these will fast become shop favorites because they were handmade and done well.

Having a lathe is not absolutely necessary to guitar making, however it can increase the amount of things that can be made in the shop, which in the long run, will make a better woodworker and guitar maker.

THE DRILL PRESS

A drill press is essentially a very controlled and extremely accurate method of drilling holes into wood. This may not sound like much at first, but being able to drill a perfectly straight hole is a very valuable asset. Straight holes require less fussing to get pieces to fit together, the screws go in nicer, and the inlays fit better.

Drill presses are made for many different woodworkers, and for many different applications and projects. Large floor standing drill presses accommodate huge pieces that require drilling, though the head still only travels downwards around the same distance as a regular sized press. Very tiny drill presses exist in the world of pen making, where a blank that will be no longer than a few inches will need to be drilled, and the pieces are so small that they are not a problem lifting into the press.

Drill presses are measured in a couple ways, mainly to do with the size they are in general, the distance the spindle will travel downwards with the rotating bit, and the number of speeds the press can achieve. Most presses are table top mounted, have around 4" of travel for the spindle, and can be changed into at least three speeds.

Methods for speed adjustment vary, but usually they are done by opening the top of the machine and adjusting a belt to a different pulley, thereby changing the speed. Some models have electronic adjustments that

are a little smoother, and essentially vary the amount of power going to the motor in order to change the speed.

The table top will adjust up and down to accept different thicknesses of stock to be drilled, and can be locked into position once the correct placement is found.

For guitar making, a bench top drill press of a medium size will be perfect, which will be much larger than the pen making drill presses, but also much smaller than the floor standing units. The throw distance on the spindle will be in the neighborhood of 4"-5", and it will have an adjustment that will allow for a few different speeds.

When drilling most pieces of wood, a fairly quick speed is used because the drill moves through the wood so quickly that the drill cannot heat up enough to cause a problem. With metal however, the speed needs to be slowed down quite a bit in order to prevent the drill from heating up, and ruining the temper. Once the temper is gone, the bit will dull very rapidly, and become ineffective within seconds of being forced through a piece of metal. If making truss rods, being able to drill through small pieces of softer metal will be a necessity.

The drill press offers as its main component the ability to drill a straight hole without worrying like when using a hand drill. When inlaying round fret markers, this is incredibly important, and will make a difference in a good and a great looking fretboard. A drill that goes in on an angle actually makes a wider hole on one side than one going in straight, which will show possibly as a gap in the inlay. If drilled in a drill press and perfectly straight, those gaps would not be present.

Using a plug cutter is almost impossible with a hand drill, however it can be done sometimes. When making custom fret dots, the plug cutter can be ran on the drill press, making very even plugs which will also inlay better.

Peg head holes for the tuning machines, soundholes, rosette inlay rings, and bridge pin holes can all be done with a higher degree of accuracy with the drill press. Bridge pin holes especially are far easier to drill on the drill press, and will be perfectly straight for the reamer which will taper the holes later.

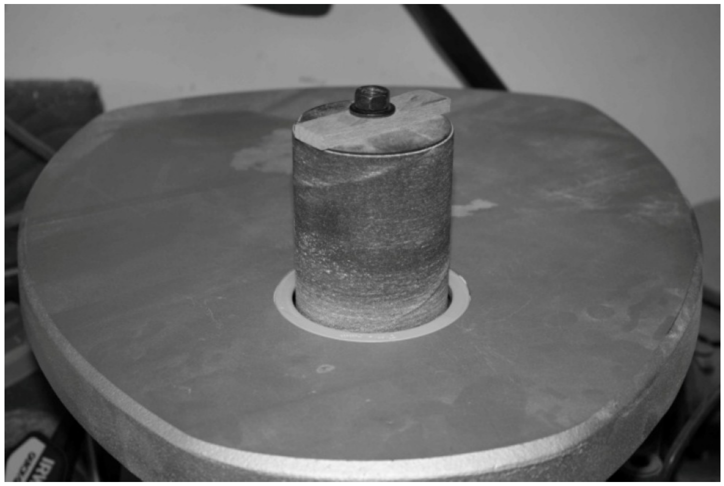
The drill press is an often used piece in the shop, and is well worth looking into if deciding upon a new tool.

POWER SANDERS

There are many different sanding options available to the guitar maker, and each of them will bring a different element to the process. There are many sanders out there, however the three most commonly used in my shop are the palm sander, the oscillating spindle sander, and the belt/disc sander.

The palm sander is a true work horse of sanding, and will get many hundreds of hours of use if sanding instead of scraping. The sander in the picture is a DeWalt, and is over fifteen years old. A good brand and a reliable palm sander will make the final sanding process much easier, and will result in better looking guitars.

These sanders come in many different styles, so the best thing to do is get a sander that feels comfortable in the hand, and something that takes quarter sheets of sandpaper. This way large packs of sandpaper can be purchased, and the squares cut from them, reducing the sandpaper expense by more than half.



The oscillating spindle sander is a powered sander with a vertical sanding drum and a flat table to rest the piece of wood on. The center drum can be swapped out for different diameters as needed, as well as for different grits of sandpaper. The process is easy, and grits can be changed out very quickly.

These are useful for sanding and shaping the bridge, trimming the peg head veneer flush with the shape of the headstock, and flattening any plate overhang.

They can also be used as a thickness sander by clamping a tall flat rail to the table top, and running thin pieces past the spindle. This will work well for thinning smaller items like fretboards, peg head veneer, and guitar sides. It is very valuable to have a method of getting a piece down to a certain thickness in a reliable and accurate way. The spindle sander can do this very well, and they are not terribly expensive.

The belt/disc sander is the bread and butter of the guitar shop, and will be used on a daily basis for many different reasons. Sometimes simple chamfering or rounding of sharp edges is needed, which the belt sander is perfect for. Guitar necks can be shaped and carved almost completely on the belt sander, and it can remove a ton of material very quickly.

Internal braces can be shaped as well as arched on the belt sander following markings from a template. The braces can all be tack glued together before this process begins, resulting in perfectly arched braces.

The disc sander will be used any time something needs to be squared, or when an angle needs to be sanded onto something, like when beveling the edge of the headstock veneer. It can also be valuable in squaring small pieces of wood like bridge blanks.

THE SCROLL SAW

A scroll saw is not necessarily the most useful tool in guitar making, however few little things that it is excellent at make it nice to have in the shop. A scroll saw is a special tool used to make very fine cuts in very tight quarters, and has the ability to make an inside cut. This means it is very helpful when making templates, and when cutting fine pieces for custom rosettes.

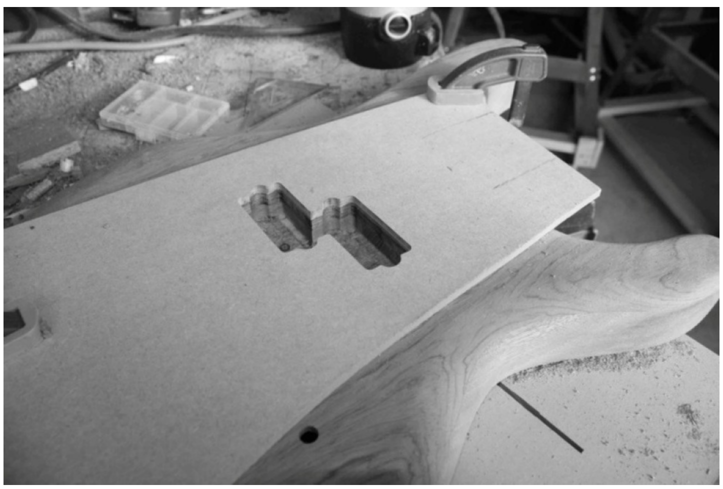
Anything a scroll saw can do, a coping saw can also do by hand, so make the scroll saw one of the very last purchases when looking around for new tools. They do however come in a number of sizes and quality levels, with some saws that can make elaborate works of art out of thin pieces of wood.

Most will have a tilting table, though for guitar work it may never end up being moved. The blades are very thin, and also come in different styles for cutting different kinds of material. They can be larger or smaller, and some can cut in any direction because they have teeth on all sides. These are used when turning a piece to cut it with a traditional one sided blade will not work, normally because the hole to be cut is very small.

All models will have a small dust blower to keep the sawdust from covering the top of the piece and making it hard to see where the saw

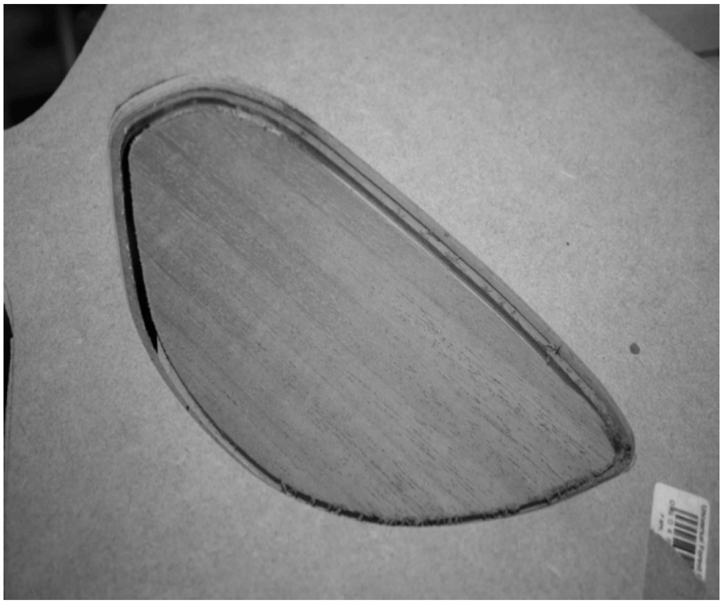
is cutting. A holder is locked in position over the piece being sawn and it helps to keep it against the table top while being cut. This is important because the pieces tend to be very thin, and being pulled too hard can crack them.

When selecting a saw, look for something on the small to medium side, and a unit that takes several blade types. The blades should be easy to swap out when needed, and there should be a variable speed adjustment as well. The speed adjustment is important because some woods will do better with a higher speed and some better with a lower speed.



The greatest use of the scroll saw comes in the ability to make inside cuts, which is a special kind of sawing where there are not any entrance or exit cuts. The picture above shows a split P bass pickup routing template that was made on the scroll saw, and used to route the pickup cavities in this electric bass.

To make the template, the shape is drawn on the piece of MDF, and then it is taken to the drill press to make a starting hole for the saw blade. The blade is threaded through the hole and into the saw, and the shape is cut out. Typically, the saw will leave such a nice and smooth edge in MDF that it will require no further shaping other than a light sanding or filing. This template can then be taken directly to the instrument it is needed for, and used.



The scratch plate being cut out of Mahogany in the picture above was done with a template and a router bushing. This method of cutting out a piece of wood makes a perfect fitting inlay, which is in this case an electronics cover for the back side of an instrument. The scroll saw was able to make this large oval shaped cut in a few minutes, and the inside edges required very little sanding.

THE JOINTER

A jointer is a nice tool to have around the shop, however most of what the jointer can do can also be done with other tools. This is not a necessary tool for guitar making, but it is useful if it already resides in the shop. Essentially, a jointer is a small planer, which smoothes out the edges of boards in order to prepare them for gluing. The machine is called a jointer because it literally prepares the joints so they fit well together, making them glue better, and look nicer when done.

For guitar making, the jointer can be useful in preparing the edges of the plates for book matching, and also for flattening out the long edges on the sides before gluing. The plates are folded over like closing a book, and are ran along the jointer fence and over the spinning blades. This flattens and smoothes out their edges, and gets them ready for gluing.

Jointers are similar to planers, and they have a table top with a set of rotating blades under a cover in the center. One of the tables is slightly higher than the other, and when the piece is fed through, the blades remove a sliver of wood from the edges. This process is done over and over until a flush edge is created.

A small jointer is useful in the shop, but along with the scroll saw should be one of the last purchases made. Since it only does a few

things, there are many other tools that are more valuable to have.

When selecting a jointer, look for a table top model that is large enough to handle soundboards and back plates, which are usually labeled as 6" models, designating the blade width. This is more than adequate for jointing boards, and some smaller pieces like peg face veneers can also be thinned on the machine, provided a jig or a push stick is used. A jointer can be a dangerous tool if fingers get into the spinning blades, and every precaution should be taken with this tool as with any other.

THE MITER SAW

A miter saw is a tool with a rotating blade that is used to cut pieces of wood to length. This done by placing the piece under the saw, and bringing down the rotating blade until it passes through. The blade can be adjusted to many other angles besides 90 degrees, and on some models it can also be tilted from side to side, which creates a compound miter.

The miter saw is very useful for those who are making a dowel joint between the neck and the body of the guitar. Since there is no tenon that is carved into the heel of the neck, it can be cut flat with a saw, and glued with dowels right up against the shoulders, exactly the way it is. Since all necks tend to have a little bit of back bow, making the neck easier to play, the compound miter saw can assist in making this angled cut.

Before the neck is carved, and while there is still a straight edge, the blank is placed in the saw and the blade tilted off of 90 degrees by around 1 or 1-1/2 degrees, and a cut is made. This causes the neck to angle backwards slightly when installed on the guitar, and also makes the strings pass over the soundboard a little higher. For domed soundboards, this is needed otherwise the strings may lay on the upper frets, making the instrument unplayable.

When looking for a miter saw, select a model that does allow for a compound miter, because it will be able to be used to cut a precise angle in the heel, which makes a seamless dowel joint a very easy possibility. Most will have 10" or 12" blades, both of which will be fine for guitar making.

Finally, a miter saw can be used to cut small slices off the end of a piece of very figured wood, which can be used for making rosette tiles. The saw leaves a very smooth edge when compared to the band saw, which means the tiles can be used right away without having to sand them forever.

THE BEALL BUFFING SYSTEM

One of the simplest and the most effective methods of buffing a bridge, fretboard, or other small wooden parts is the Beall Buffing System. This is a method of buffing wood directly, where three buffs are used, two with abrasive compounds and a third with carnauba wax. It can be used on almost any electric motor with the included shaft adapter, and there is also a version for use on the lathe.

Using the Beall buff to polish bridges and other small pieces of wood, it really does not matter which system is chosen. If there is a motor already present in the shop, purchase the free standing version. If a lathe is already available, get the kind that comes with a lathe mandrel.

Directly polishing wood using abrasive compounds is fairly new to the instrument making shop, but it is an old friend to those who make handmade tobacco pipes. Once a pipe has been shaped and sanded down to a fine grit, the buffing wheels are brought out in order to create an extremely smooth surface.

Polishing by hand would take forever, so using compounds on wheels is done instead. They first start with a tripoli compound, then a finer compound called white diamond, and finally buff on a layer of carnauba wax. All that is on most fine smoking pipes as far as a finish goes is a light coating of carnauba wax, which melts at a high temperature, making it excellent for coating tobacco pipes.

The system itself comes with three buffs, which is the basis for how the polishing process works. One wheel is for use with the tripoli compound, which looks like a reddish orange cake, and is the most abrasive of the two compounds. The second buffing wheel is for the white diamond compound, which is finer than the tripoli, and is used to remove any final scratches left behind. After the white diamond buff comes the wax buff, used to apply carnauba wax.

These are the three buffs that come with the system, though more can be purchased and used with different compounds later on. For example, a fine jewelers rouge can be bought and used after the white diamond, polishing the finish even finer than it could have been with the white diamond. A new wheel will need to be purchased for each new compound, because mixing compounds will make them completely ineffective.

The Beall Buffing System does not come with three wheels because the owner likes you. It comes with three buffing wheels because the compounds need to be kept separated in order for them to work properly. If the white diamond and the tripoli were applied to the same buffing wheel, it would cut just like the tripoli only, because the more abrasive compound will be the dominant compound.

The same goes for mixing wax and one of the compounds. This will not speed up the process, it will only ruin one or both wheels and do nothing to make the wood look nicer.

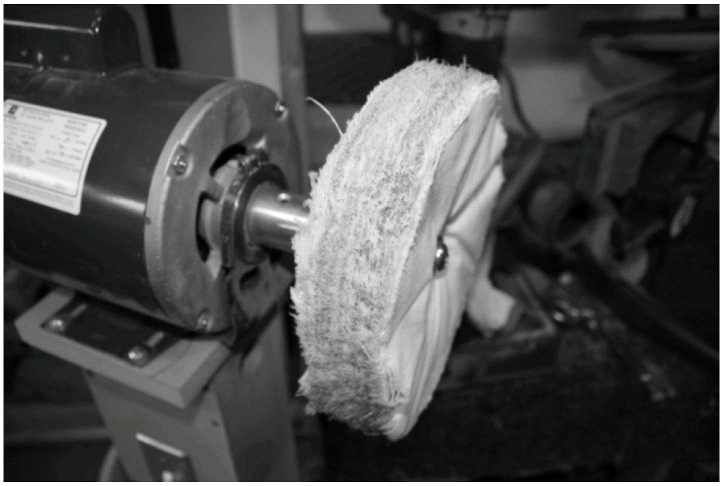
Any time a new type of compound is going to be used, purchase a new buff, and use it only on that wheel. If a more abrasive compound is being used, purchase the tripoli style wheel to apply it to. For finer compounds, purchase the white diamond style wheel from the manufacturer, and apply the new compound to it. The tripoli wheel is a little rougher than the white diamond wheel, which is why buying the correct wheel for the correct type of compound is also important.

The compounds are shown from left to right in the picture above. The compound on the left is tripoli, the middle is white diamond, and on the right is a bar of carnauba wax. Each of these should be kept from touching each other more than necessary, in order to keep from cross contaminating them.

Depending on the system chosen, it will either come with a mandrel for the buffs that goes on the lathe, or it will come with an arbor that fits on an electric motor shaft like the picture above. In this case, since a motor was already available in the shop, the freestanding Beall system was chosen, which has the shaft adapter. There is also a shaft extension available, which moves the buff further away from the motor, making it easier to buff larger items like guitars with.

The buffs themselves go onto the shaft with a bolt that is inserted into the center threaded hole, and the rotation of the motor keeps it in place. Each buffing wheel will have one of these bolts, and it screws easily into the shaft to use a new wheel.

When screwing on the wheel for the first time, make sure the motor is off, and to carefully screw it on to prevent cross threading and ruining the shaft. Once the buff has been screwed at least half way on, turn on the motor and it will screw itself the rest of the way in. The rotation of the shaft keeps continually trying to screw the wheel on further, which prevents it from coming off while working, and flying across the shop. To begin the Beall system, first screw the wheel labeled "tripoli" in place.



The picture above shows the buffing wheel attached to the shaft, and ready to begin polishing a piece of wood. Before any buffing can happen, the wheels will need to have compound applied to them before they can work. A wheel that is brand new will not polish anything, because the wheel itself does not do any of the polishing. The wheel simply holds the compound so that it can do the actual work.

When applying compound, hold the bar below the wheel, around the seven o'clock position if looking at the spinning wheel. It is important to allow the wheel to roll over the compound in a manner that does not encourage the wheel to catch, and throw the compound at the floor.

Always apply items to the buff at the seven o'clock position, applying light pressure upwards, and keeping the majority of the piece in

the hand. To apply the compound, simply touch it to the wheel for a few seconds and remove it. The wheel should start picking up orange compound, and the edge of the wheel will begin to go from white to orange. At first, it will require more compound to initially charge the wheel, however later on it will only require a small amount every once in a while. Once the wheel has an even orange coloring to it while rotating, the buff should be ready to begin working with.

The piece that is going to be buffed needs to be sanded to 220 grit before any buffing will be effective. 320 grit would be even better, though a thorough job with 220 leaving no scratches is perfectly acceptable for buffing. In this case a piece of Indian Rosewood is being used to demonstrate how the final look would appear on a guitar bridge.

Notice in the picture that the look of the wood is fairly flat, not much definition between the shades of brown, and there is not any gloss to the piece at all. This is how the wood looks before buffing, which will be dramatically different afterwards.

Before buffing, and even while applying compound, it is a good idea to wear breathing protection in the form of a respirator or a paper dust mask. The fine particles of abrasive compound are not good to breath in, and it should be minimized as much as possible.

Touch the piece to the spinning buff at the seven o'clock position and carefully apply pressure to the top half of it. Feel the buff as it rotates over the piece of wood, polishing the surface and darkening the color. The darkening is coming from the surface being smoothed as well as the binder that holds the tripoli compound in bar form.

The piece should be held against the buffing wheel for a few seconds at a time and then removed and inspected. Make sure to keep the piece moving from side to side or front to back at least a little while under the wheel, and again inspect the piece after a few seconds of buffing. If one area looks duller than another, focus on that area for a couple seconds before moving the piece all around to even out the polishing.

Looking at the piece after it has been removed from the buffing wheel, the top half is starting to polish up a little, and the definition between the grain coloring is beginning to show itself.

Reverse the piece and do the other half in the same way, letting the buffing wheel fall off the edges rather than grabbing them. It will take a little getting used to the buffing process if never having done it before. It will only take a couple grabs by the machine to teach where the best place to buff on the wheel is located, and hopefully nothing gets destroyed in the beginning. A little practice and a careful sense of respect for the buffing machine will make the process much safer, as well as make the pieces come out far better looking.

Stop the buffing motor, and remove the tripoli wheel. Put the white diamond wheel on the arbor, and turn on the machine. Apply the white diamond compound the same way as with the first wheel, again adding a little extra if this is the first time.

Buff the piece as before, though only for a third to a quarter of the time that the piece was buffed with the tripoli.

Now that the piece has been buffed with two different compounds, it is really showing off the grain colors as well as the contrast between the grain lines, and the shine. If this were a fully formed guitar bridge, it would be ready to go on the guitar at this point if desired, or it can also be wax for an even higher gloss.

Remove the white diamond wheel and place it in a safe location free from dust, and put on the wax wheel. This will be the final step to the buffing process, and will end up with a very high gloss shine provided by the wax.

Applying wax to the wheel is a little bit different than applying compound, though the results are the same. The compounds are grabbed by the fibers of the wheels, getting stuck, which loads the wheel with compound. Wax on the other hand will need to be heated and melted in order to transfer.

When applying the bar of wax to the wheel, more pressure will be needed, which will cause the bar to heat up, melt a little, and transfer the wax to the fibers on the wheel. Just letting the wheel dance over the edge like with the compounds will do nothing, and no wax will be transferred. Press the bar against the turning wheel, and in a few seconds heat will build up and the wheel will begin to color the edges a very faint yellow.

Once there is a light coating of wax on the wheel, it is ready to be used, though more and more wax will need to be added at first in order to keep the wheel charged. Once the coloring falls back to almost white, add a little more wax and begin buffing again.

Work the piece from side to side as well as front to back, doing one half of the surface at a time, and not lingering in any one location. The wheel will need some heat to apply the wax, so a little more pressure than normal will be needed to encourage the transfer.

Check the piece from time to time as the process goes on, and once the one half has an even glow to it, flip the piece over and do the other half in the same manner.

Here is the final look to the piece, after it has been through three wheels, one with tripoli, one with white diamond, and finally the carnauba wax. It was practically impossible to take a picture of the piece without it shining back at the camera, and this was the best that could be done.

The definition and the separation between colors on the surface has been brought out very well, and the piece is as shiny as it could ever be. This look was also created in about ten minutes on the buffing wheel, instead of possibly hours sanding and polishing by hand. The surface is even, the gloss level even, and the wood is incredibly smooth.

When done with the wheels, do not place them all in the same box they came in, rather place them in large plastic zipper bags. If compounds are shared between wheels, they lose effectiveness, so place each wheel in its own bag and label it according to the name of the wheel. All of these bags can go into a larger bag for storage, or they can have a hole punched at the top above the zipper lock, where they can be hung from a peg board.

The compounds will need to also be placed in individual zipper bags to keep them from cross contaminating each other, and kept in a room temperature location. When the bars come for the first time they are in the same box and possibly touching each other. This is not as big of a deal as it sounds, the idea is to keep them separated as often as possible once they are being used.

Project Notes:

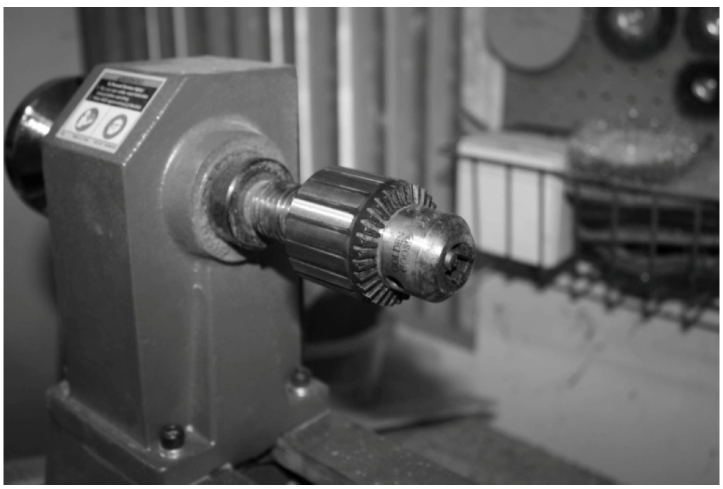
Buffing pieces of wood is a very fast and effective way to bringing them to a very high luster and enhance their look. This process can be used on more parts of the guitar than just the bridge, and there are

several places that the wood buffing method can be of use to the guitar maker. The only limit to wood buffing is the creativity of the woodworker.

The fretboard can be buffed, which will look amazing on a piece of dark and rich ebony or rosewood, and so can the bridge pin heads and end pin head. A pick guard looks amazing after a thorough buffing, and really brings out the definition in highly figured woods. If there are any custom made wooden knobs, they can be buffed as well before attaching them to the guitar, giving them a very high gloss and an almost wet look.

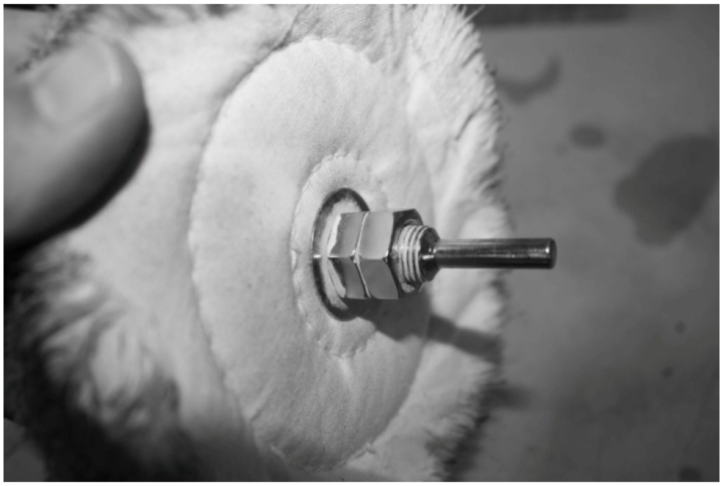
LATHE OR DRILL PRESS BUFF

If a very simple buffing system is needed, and it will really only ever be used for buffing bridges, then a single buffing wheel with an arbor is perfect. These come in single packs from several hardware stores, and can be charged up with compound and ran on the lathe or the drill press. A fast hand drill may also work, though it would have to be mounted to the bench somehow, and again it would have to turn about as fast as a higher speed drill press.



In this example, a lathe is going to be used as the power source for the buffer, and since the bridge is a small item, there will be no problems buffing it in such tight quarters.

The lathe will need to have a chuck mounted into the headstock, which will accept the arbor from the buffing wheel and lock it in place. This is a simple three jaw chuck sometimes called a Jacobs chuck, though any drill style chuck will do. Mount it in the headstock, and press it tightly in place.



Small arbors can be purchased from the hardware store separately, or in a package together with a buffing wheel. Look for a white cloth wheel and an arbor, and pick up some tripoli compound as well. The wheel needs to be smaller than the swing of the lathe, so that it does not run against the lathe bed while it is turning. If the center of the chuck is 8" over the bed, find a 6" buffing wheel to be safe.

Chuck the arbor of the buffing setup into the lathe, and tighten it in place. Turn on the lathe and set the rotation speed somewhere between 1500-2000 rpm, depending on the size of the wheel. Larger diameter wheels can go slower and still get the same job done, because the edge doing the buffing is moving faster. A smaller diameter wheel will need to be ran a little faster to make up for its smaller circumference.

Charge the buff with tripoli compound before using it by turning the machine on, and holding the bar of tripoli against the spinning wheel. Once the edge of the wheel is an even shade of orange, small pieces of wood like bridges, end pin heads, bridge pin heads, and anything else can be buffed.

Once the wheel becomes excessively dirty, use a rake or a piece of very coarse grit sandpaper against the edge of the spinning wheel. This will remove much of the excess compound as well as lighten the edge coloring a little. Use the wheel again as normal until this cleaning process can no longer be done, and then get a new wheel from the hardware store.

IT IS NOT ALL ABOUT TOOLS

Every guitar maker and woodworker dreams about having an amazing shop filled with every tool imaginable, and piles of wood so high that it looks like they will never run out. The truth of the matter is that it takes a lifetime to accumulate the large number of tools seen in most shops. As the skills expand, and extra money is available, a new tool is purchased and set among the others. Until a large arsenal of tools becomes available, it is best not to dwell on what is not there, and instead look for ways to use what is already there differently.

The guitar in the picture above on the right was made with a palm sander, electric drill, and router. That was my complete set of power tools at the time, and two of them were my father's, which made my tool list pretty small. To get around certain things, processes had to be done differently, and where books would say to use a band saw or table saw, I was using a hand saw and learning respect for those who made guitars long before power tools.

To the left of that guitar is another electric, a bass this time, and it too was made with the same few tools. A couple more hand tools were added that helped make the neck and fretboard, but the power tool roster was still the same, weak at best. Having no money for expensive power

tools, it was easier to figure out ways to use the existing tools for other jobs besides what they were directly made for. The one tool that is a complete sleeper until its true powers are discovered is the router.

A router can be used to make cuts, taper fretboards, joint the edges of boards, make circular cuts, carve out inlay cavities, make saddle slots, and route pickup cavities. Not having a jointer, the router was used to flatted the ends of the body blank before gluing the two pieces together. Edges were rounded using a round over bit, the neck pocket was made, and several other things were accomplished with the router. It is truly amazing what learning the ins and outs of a tool completely will do for the ability to use it, and by learning to do more with less in general.

An expert guitar maker with a few tools could do far better than an amateur in a fully operational guitar factory. It has far more to do with using what is already in the shop than buying a new tool every time something different comes up.

Before buying a new tool, spend some time with the tools that are already in the shop, and really get to know what they are capable of. Look into purchasing a book that teaches the basics as well as advanced techniques with each tool, and do a little reading when not in the shop.

A good book on a power tool will open the eyes and expand the capabilities of the woodworker, since the tool was already capable of doing all those things the book will teach. If the user does not know the router can

be used to flatten the edges of boards, they will always believe a jointer is needed, and that limitation in the mind will prevent success. Knowledge is the key to being able to do better with less, and it will always be better to have knowledge than tools.

Think back to the old masters, making instruments with hand tools by candle light. They had none of the tools and shop setups that are available today, and they still made instruments that were sought after by top players. Even today, their craftsmanship is marveled at, and their abilities inspire modern luthiers. The moral of the story is that if one man can make hundreds of violins in an Italian shack by candle light, anyone today with the tools and technology we have can learn to do the same. It is more about using the tools that are already in place and learning them thoroughly, than it is about buying new tools to solve every small dilemma.

CHAPTER FOUR

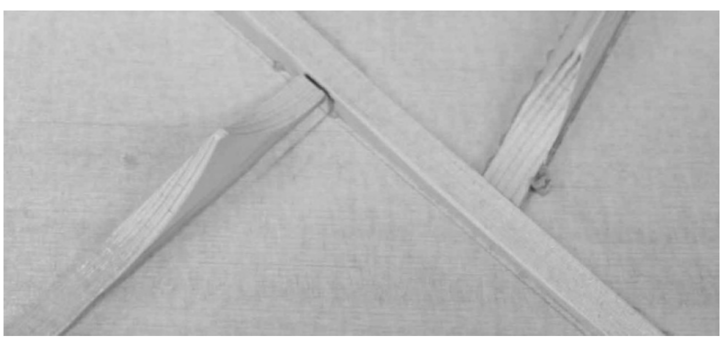
GUITAR MAKING THEORY

The science of guitar making is a field of study all its own, and a lifetime can be spent learning all the subtle qualities of wood and structure. However, knowing a little bit about construction theory can go a long way towards understanding why a guitar works the way it does. After all, understanding why will help us figure out how to get there.

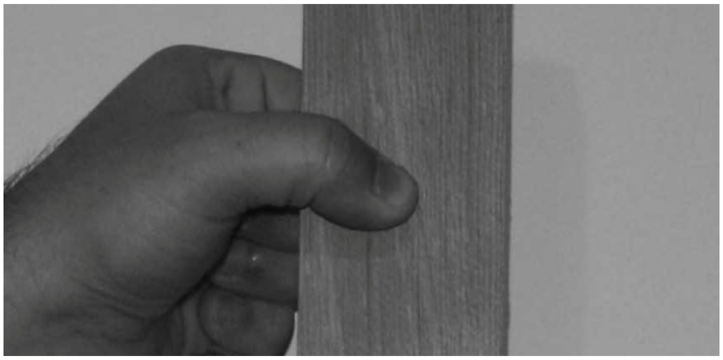
Here we will touch on some items that are important to know while making guitars, and things that will help in making good decisions about how the guitar should be made. Understanding these few basics will definitely help to make better guitars.

Knowing why a guitar does what it does and what it takes to make it work better, is really the key to making consistently good guitars. It is not as important to get one big thing right, but rather to get many small things right that add up to something bigger than them all. Doing each little step correctly, and making the correct decisions based on a solid foundation, will ensure that great sounding guitars are consistently made.

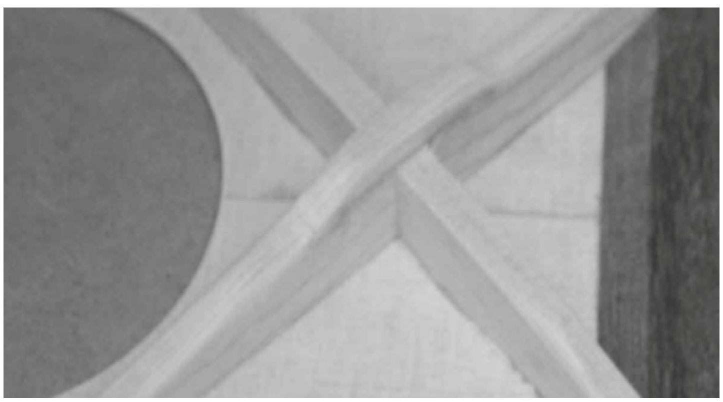
In This Section We Will Cover:



The height and width of the bracing and how it effects plate stiffness and tone. See here.



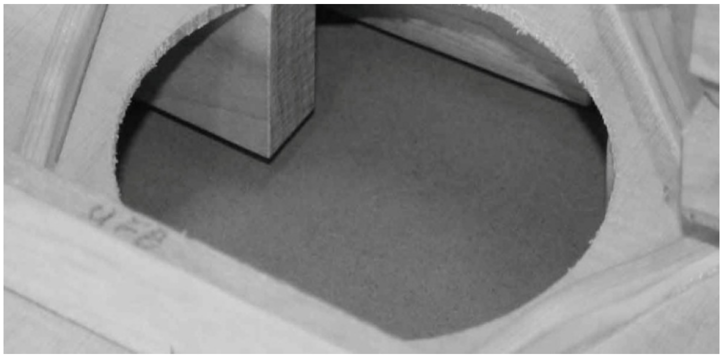
Tapping pieces of wood and listening to the sounds they make. Tapping for tone. See here.



The spread of the x-brace and how it effects stiffness and tone. See here.

Capping the x-brace to help strengthen the joint, as well as improve vibration. See here.

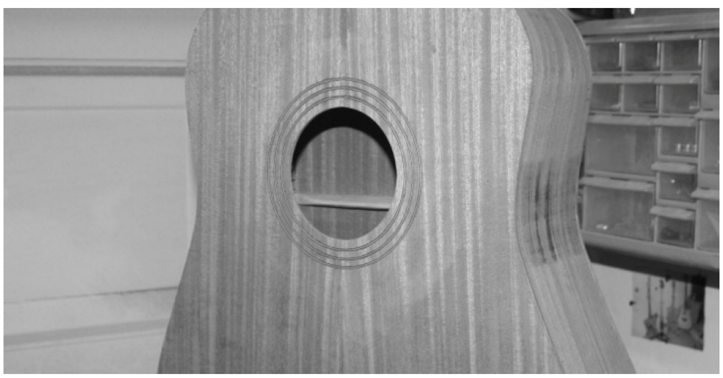
Trapping the ends of the braces under each other for structural stability over time. See here.



Soundhole bracing, and how sound travels over and around the soundhole. See here.

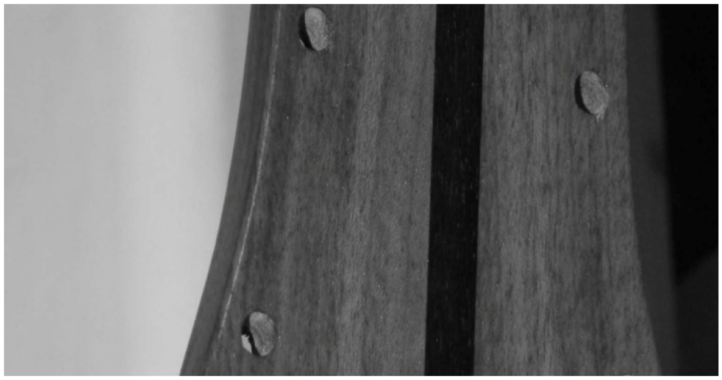
The volume of the sound box, and how it effects the sound of the guitar. See here.

The bridge and bridge patch, and how they hold the strings and transfer vibration. See here.

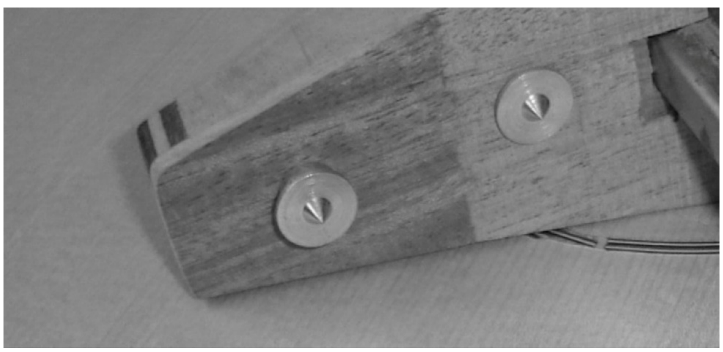


Doming the plates, and how to secure them to the sides afterwards. See here.

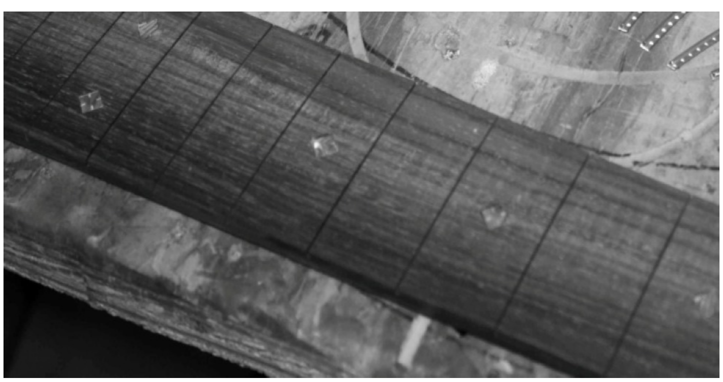
Beveling the rim after assembly, and how a thinner rim helps with plate flexibility. See here.



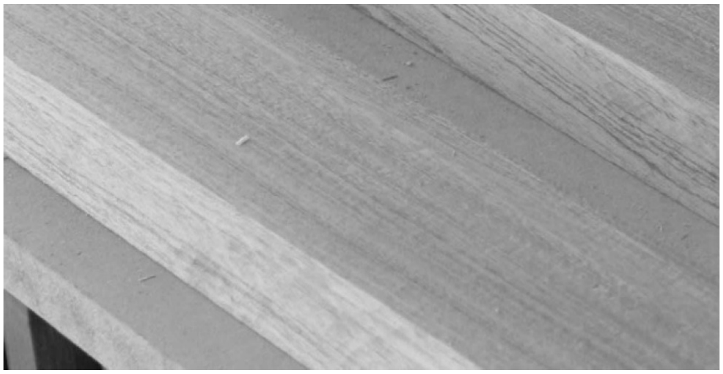
Building necks for sound quality and to retain vibrations well. See here.



The neck to body joint, and why it makes a difference when done well. See here.

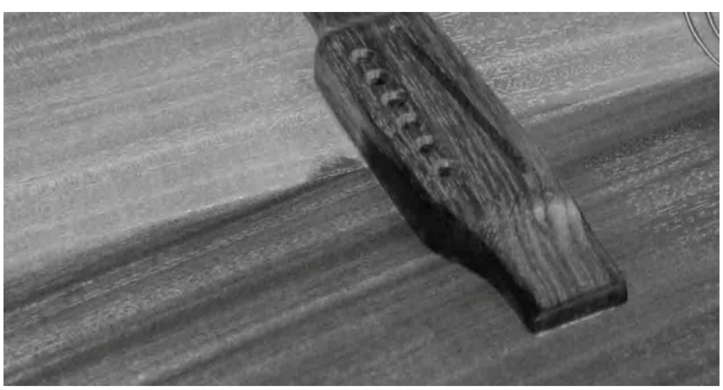


How to create a custom scale length using math and the rule of 18. See here.



How to identify and select great pieces of wood to make guitars from. See here.

Master grade wood, and why it may not be everything it sounds like it would be. See here.

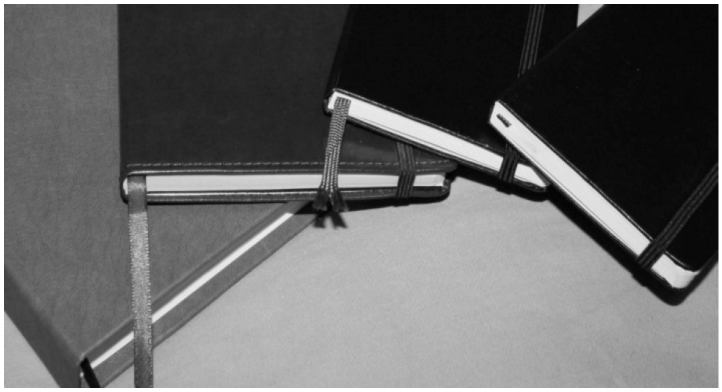


Finishing a guitar with emphasis on sound quality and plate vibration. See here.

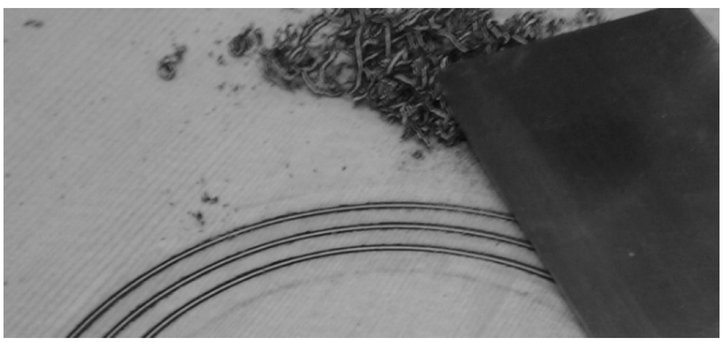
How the bridge and saddle work together to make the top vibrate. See here.

Nuts and saddles, and the best way to place and shape them. See here.

Alternative tone wood, and how there is more out there than Rosewood and Mahogany. See here.



Documentation, through taking pictures and recording important data for future use. See here.



Getting everything mostly right, and how small things get in the way of guitar making. See here.

Project Notes:

It is far more important to know why a guitar will act in a certain way depending on what part of the instrument is changed. Following a plan with neat dimensions and set sizes is fine for the first few instruments, however over time it becomes more important to understand the properties of each piece. It is in this way that subtle changes can be made to the structure of the instrument, allowing the

maker to mold the sound to suit a certain style of playing or customer request.

SHAPING THE BRACES

The main function of acoustic guitar bracing is to ensure that the force of the strings does not distort the top or destroy the structure of the guitar. The strings will exert anywhere between 150 and 200 lbs. of tension between the neck and bridge, which is the equivalent of an average sized man standing on the guitar. The forces that would destroy a guitar if left unchecked must be balanced with good bracing, but not too much, otherwise the sound would be muffled and weak.

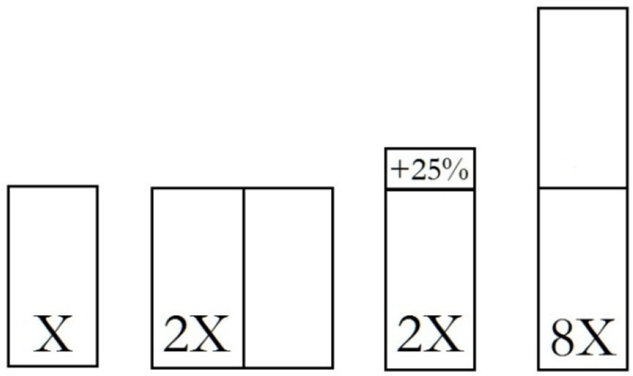
It is a balancing act to determine how much bracing is needed to keep the guitar structurally strong, yet allow the plates to vibrate enough to produce a pleasant sound. This is where a little structural knowledge in how braces work can be valuable. The main point of the exercise is to make a light yet strong set of braces, that will vibrate well and maintain the structure required to support the bridge and strings.

The shape of the bracing plays a key role in how strong a brace will be. This can be demonstrated with a wooden ruler. Grasp the ruler laying flat, and with a hand on either end, give the ruler a little bend. Feel how much pressure it takes to bend it, and repeat this a few times to really get the feel for it. Now, rotate the ruler so it is on edge, and try bending it again. It is much harder now than it was before, and that is because the ruler is taller, and we are trying to flex through more wood than before. The size of the stick and the weight did not change, but by changing the orientation we can significantly change how strong something is. In fact, one ruler on edge is harder to bend than several rulers laying flat.

Taking advantage of this physical principle, it is easy to see why many great guitars are made with braces that are taller than they are wide. Luthiers know that they can get the right amount of strength for less weight by doing the braces this way. All the large structural braces on an acoustic guitar top are made like this, with the exception of the upper face brace. This piece is usually as wide as it is tall, however the same strength could be had with a thinner and taller brace. The finger braces that extend off of the x brace are also an exception, however they are normally carved so thin they might as well not even be there. They do more for radiating vibration

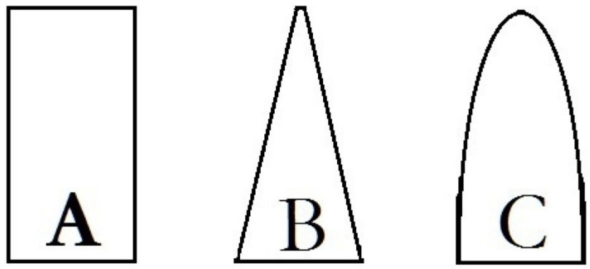
out towards the rim of the guitar rather than supporting any structure, so they do not need to be tall to be functional.

The main structural elements, the x-brace and lower face braces are all normally taller than they are wide, because they will be dealing with the largest amounts of stress.



The first step in deciding how to cut the brace blanks is to get a good visualization on how the height really effects the strength. The above diagram shows the end profile of several brace options. Everything other than cross section is equal. The braces are the same length, of the same species, and cut from the same board. The brace on the left has a certain strength we will call X. If we were to cut a piece twice as wide and the same height, it would be 2X (two times) as strong as the first piece. It should make perfect sense that there is twice as much mass, so the piece would be twice as strong. The third piece is the same width, but only 25% taller, and it is also twice as strong as the piece on the left. In fact, doubling the height like in the last piece, will actually increase its strength by 8 times that of the first piece. From this example it is easy to see that a small increase in height can make a brace stronger without making it that much heavier.

The next step in making braces lighter and stronger is deciding how they will be profiled after they are glued into place. This refers to how the brace would look if a cross section were sliced off.

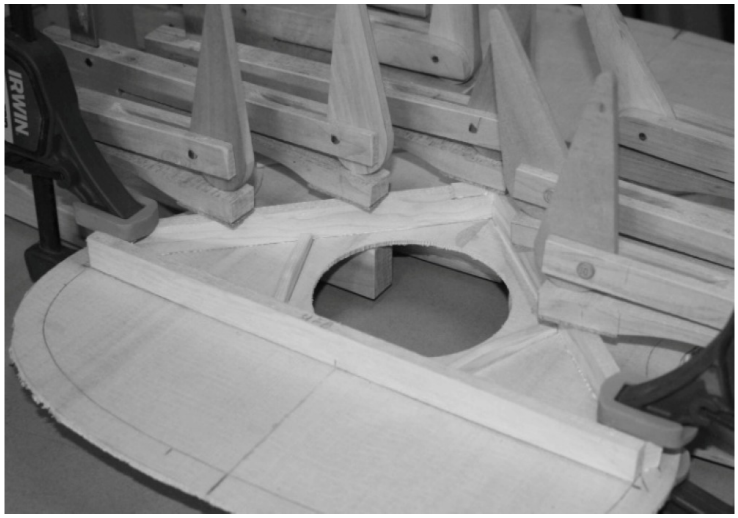


The diagram above shows three different profiles for a guitar brace. Brace A is what an un-carved brace would look like after it was cut and glued into position on the guitar top. Brace B shows the same sized piece of wood, carved into a triangle with half of the wood removed. Lastly, C shows a brace with a parabolic carving profile, where a large portion of the wood has been removed, but not as much as B.

The advantage of A is that it will be the strongest brace in the set, assuming that all else is the same. It will withstand the forces of the string tension well, and probably never distort over time. The only disadvantage with brace A is that it will be significantly heavier than the other two, meaning that sound quality may end up taking a back seat to strength.

Brace B has had as much wood as can possibly be removed from it without lowering the height. It has lost half its mass, but none of its height. This brace is only slightly less strong than brace A, however there is not much wood left at all. The main disadvantage for this kind of profile is that it is hard to carve without digging into the top with the chisel, and removing so much structure and wood hardly leaves anything left for sound to vibrate through.

Finally, brace C is a hybrid of both, because it keeps some structure but also loses some mass. The parabolic carving is far easier to accomplish while the braces are glued into position, and there is still a good portion of dead weight being removed. This lightens the brace without altering its structural abilities by more than a few percent. It is the best of both worlds when it comes to structure vs. weight, and it will allow for a better sounding guitar.



The thickness and bulkiness of the upper face brace can be solved by halving the width of the piece and adding 25% to the height. An original brace dimension of 5/8" x 5/8" can be replaced by a new brace at 5/16" wide and 13/16" tall, without changing the structural stability. This means there will be a reduction in weight by almost 40%, but no change in strength.

The above picture shows the upper face brace having already been glued into position with the x-braces being clamped while the glue dries. The height and width of the brace blanks are the same size for both the x-braces and the upper face brace.

The picture above shows a common layout and size for most of my bracing. Every brace on here started as a blank that was 5/16" wide, and 4/4 tall, with the exceptions being the finger braces and the sound hole braces at 1/4" wide. The nice thing about having all the blanks start out the same size is that it is very easy to set a stop on the table saw for 5/16" and run the piece of spruce through until there are enough blanks to do a complete guitar top. Plus, the reduction in weight makes for a more responsive top that does not need as much string energy to excite.

When carving the braces from blanks, start by shaping the ends and tapering them towards the edges of the top. After that, carve the parabolic profiles into the main braces. When tapped, there should be a nice clear sound that comes from the plate. The tone should drop as more wood is removed, and the sound should be checked often as this process of wood removal goes on. Removing wood from the tops of braces will cause the tone to drop quickly, and removing from the sides will cause it to drop slowly. The tone drops faster when removing wood from the top because the strength is reduced quicker. As wood is removed from the braces and the tapering gets longer, take some time to re-carve the parabolas into the braces, and listen to the tap tone.

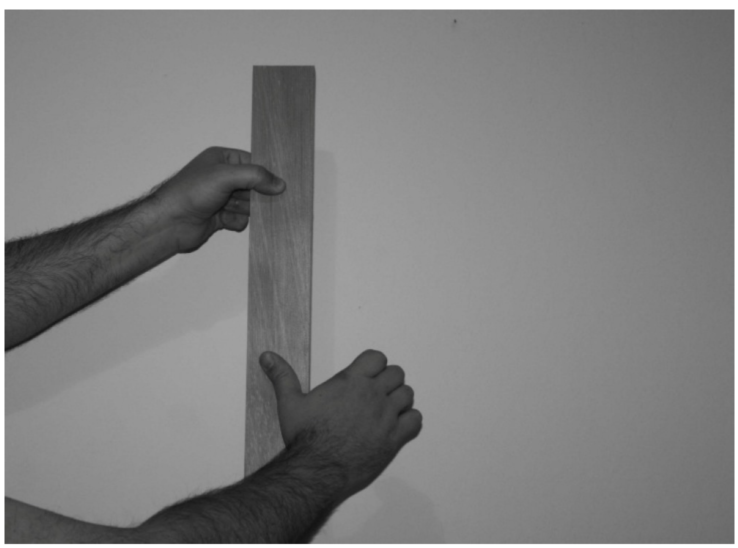
Project Notes:

Getting the bracing as close as possible to the layout on the template, is more important than getting a tone correct. The main idea is to reduce the mass of the top, making it lighter and more responsive. As long as any bracing created is close to the standard, it will sound just fine. Tapping for certain sounds will come with time, but it is more important to listen to the changes in the wood than the actual sound it makes.

TAPPING FOR TONE

Listening to the sound that the guitar top makes while being struck at the bridge location can help to add another layer of knowledge. It is not the most important thing to listen for a certain sound while making a guitar, but it is important to hear how removing wood from braces and thinning plates can change the response of the top. Tap tuning is not an exact science, but the knowledge gained from using as many senses as possible while making a guitar makes a difference.

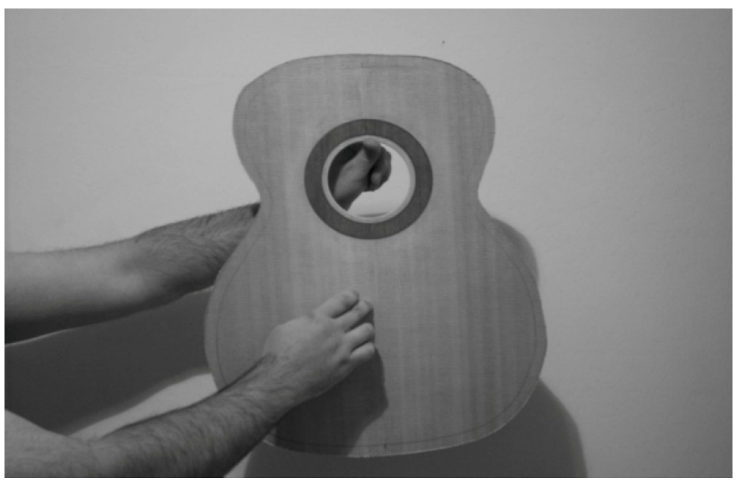
All kinds of wood can be tapped and listened to while evaluating them. The process should start at the wood store, which can be a real eye opener. Pieces of wood that look very similar and are of about the same size can have very different tones. There can be two virtually identical pieces and one will ring like a clear bell and the other like a knock on a screen door. A "dead" piece of wood can be discovered this way before it is ever bought, and the problem of a flat and lifeless sounding guitar avoided.



To tap regular lumber when at a hardwood store, start by grasping the piece with the left hand between the thumb and first finger. Grab it about a third of the way from the top, always holding the faces. Tap it with the side of the thumb of the right hand, while holding it near the

right hear. The tap must hit around a third of the way from the bottom. The nodes on most pieces of wood will be at the thirds, so holding one third from the top and tapping one third from the bottom will allow the piece to flex and vibrate. If the piece does not vibrate well, or the sound dies off quickly, adjust the holding hand a little bit up or down. If it gets worse, adjust it the other way, if it gets better then keep making small changes until it is the best it can be. This is the tone of the piece of wood.

The sound that should be sought after is a long resonating solid sound. It will not be very loud, but it will have sustain, warmth, and a life to it that can easily be understood once it is heard. Especially large boards can be made to produce very powerful bass notes that resonate several seconds. Smaller boards will produce higher sounds that die off faster, but it is important that they are resonating clear and strong though the tone.



When tapping the top plate, balance the guitar top vertically by the sound hole on the left thumb only. The top should be facing right, and the braces facing left. Tap the bridge location and listen for a resonating sound from the wood. If the sound deadens out very fast or is very high pitched, continue removing wood. When the tone lasts about a second after being struck, and has a nice warm tone, the carving is done. This will take time to understand until several guitars have been made, but it is still very useful information.

The reason to tap the parts of the guitar as well as the raw wood is to develop another sense to assist in guitar making. It will help in the hardwood store to avoid pieces of wood that sound lifeless, and it will help

in the building process to know when a guitar top starts opening up and coming to life. It is worth picking up a few pieces of wood in the shop and tapping them for a while. It is really easy to start seeing the differences between hard and soft woods, as well as denser, shorter, and thicker pieces.

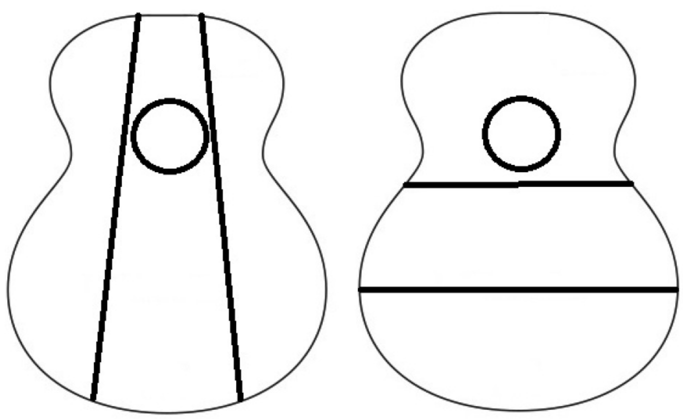
Project Notes:

If a piece is tapped on the faces it will make one distinct sound. If the piece is turned and tapped on the edges, it will make a much higher sound. The tap tone through the faces is a better indicator of board quality, and a board that vibrates well is usually an excellent piece to make a guitar with.

X-BRACE POSITIONING

The x-brace is arguably the most important piece of wood that will be glued to the guitar top, so it is worth knowing a little about how it will affect the tone of the resulting instrument. The placement of the x-brace, as well as how open it is, can significantly change the structure of the top as well as the acoustics.

The main point of the x-brace is to keep the top from collapsing under the tension of the strings, while helping radiate vibrations across the entire surface of the top. This large brace covers almost the entire under side of the top, so the influence on tone is significant to say the least.



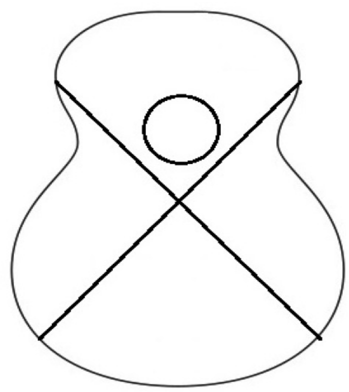
The diagram above shows the two ways a set of braces can be laid without crossing them like the x-brace. They can be laid vertically or horizontally, and something very different happens in each example.

The guitar top on the left will be very strong under the tension of the strings. The braces run right in line with the force, and they are in perfect position to counteract it. However, where it lacks is in the top being able to move freely under the vibration of the strings. The braces are so rigid in this design that they do not allow much motion in the top, resulting in a muffled sound.

The guitar on the right has the braces laid horizontally, giving almost no additional resistance to the tension of the strings. Many guitars

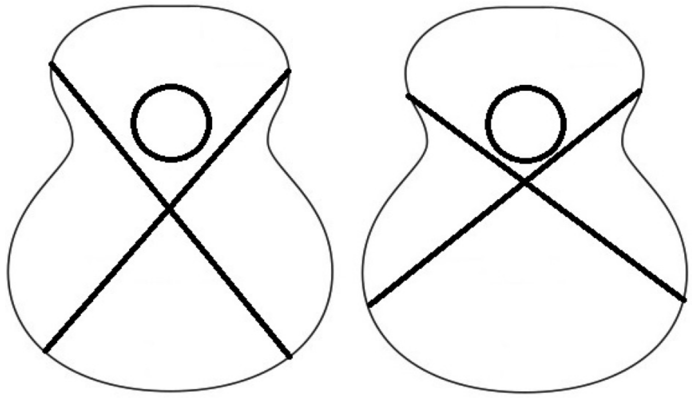
from years gone by were made with this kind of bracing on the top, and they were good sounding. The issue with this kind of bracing is that there is really not much in the way of structure to help keep the stress of the strings from deforming the top.

It would seem that there would have to be some sort of middle ground between the two bracing styles, where the strength of the vertical bracing and the looseness of the horizontal bracing could both shine through the final sound. That is where the x-brace comes in, and meets them both in the middle.



The x-brace combines the strength from the braces running top to bottom, and the looseness in the center of the plate from the braces running left to right. The bridge area and below it are wide open and can have the freedom to flex, but the overall plate is covered top to bottom with supportive braces.

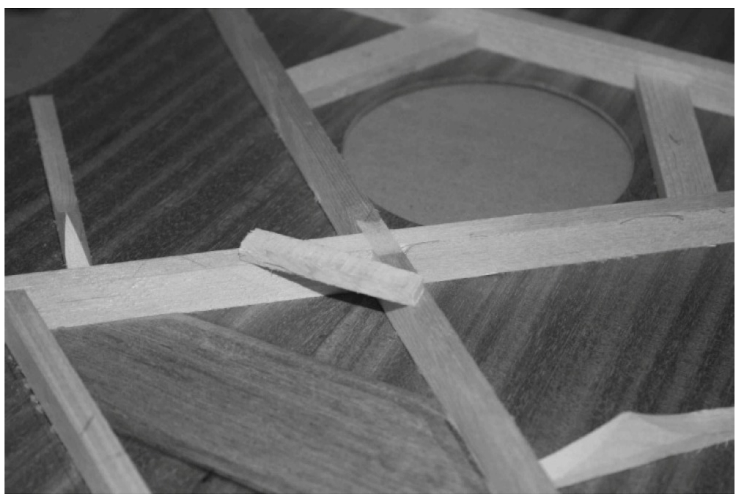
There are a couple of things to keep in mind when setting the x-brace that will influence the tone. One of these is how wide the brace opens, and the other is where the braces are in relation to the placement of the bridge. Both of these factors will help shape the sound of the resulting guitar, and are worth taking into consideration when building.



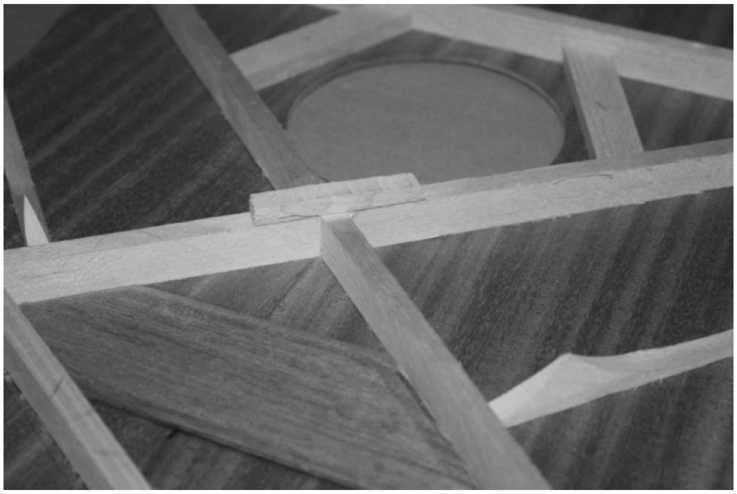
The picture on the left shows a narrowly placed x-brace, where the sound characteristics will be more like the guitar earlier where the braces ran top to bottom only. The one on the right shows a widely placed x-brace where the intersection point has moved closer to the sound hole. This kind of bracing is closer sonically to the horizontal style. The guitar on the left will have better structure and more rigidity in the plate, and the guitar on the right will have a looser bridge area, allowing more sound to project from the instrument. A happy medium can be found here just as before. Where the guitar on the left might require thicker strings to get the torque required to drive that stiff of a board, the guitar on the right may deform too quickly under the string tension without additional bracing.

X-BRACE CAP

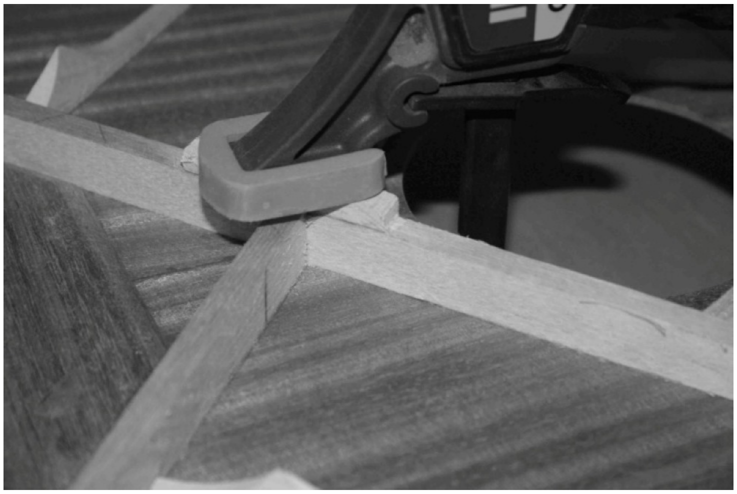
Where the x-brace intersects at the center, there is a lap joint, which is necessary for the two pieces to pass through each other. This causes the piece with the lower notch to become weaker than it should be, and less able to pass vibrations. A simple solution to this problem is to install a small cap made from the same material as the braces. It serves to add mass to that brace, help lock the two braces together, and is a small extra step to help ensure good tone emerges from the final instrument.



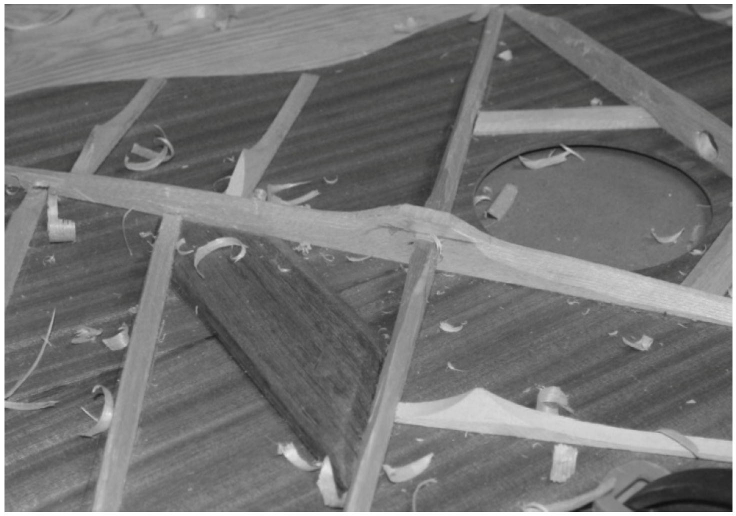
Cut a small cap about 1/4" thick and 1-1/2" long from a piece of unused guitar brace. The wood species should be the same, and it should be easy to find a cutoff from the braces that were just cut and glued. The width should also be the same as the x-brace.



Place the piece as seen in the above picture, on top of the brace that has been cut to allow the other one to pass over it. This will seal the lap joint, and make the braces act a little more as one. Sand the x-brace as well as the bottom of the cap if needed, to make a nice surface for gluing.



Glue the cap in place with Titebond wood glue, and clamp it in tightly until the glue dries. Make sure there is nothing stuck on the face of the clamp that is against the front of the guitar top, which might leave a ding in the surface that would need to be removed later.



Once the glue has set, the cap can be carved so that it flows into the general structure of the x-brace, and looks like an integral part of the wood. It will always be a little tall, but since it will be on the inside of the guitar, nobody will notice. Do not remove too much of the mass of the cap, because part of its job is to add that mass back into the cut brace.

Project Notes:

Some luthiers even go as far as adding little triangles of wood to the corners where the x-braces meet. These serve to further lock the braces together as one solid piece. Though I do not do those here, I have before, and they do make sense according to the physics involved. The x-brace acts as a huge conductor of vibrations all around the guitar top, so making sure it is locked together with a cap or other methods is a good idea.

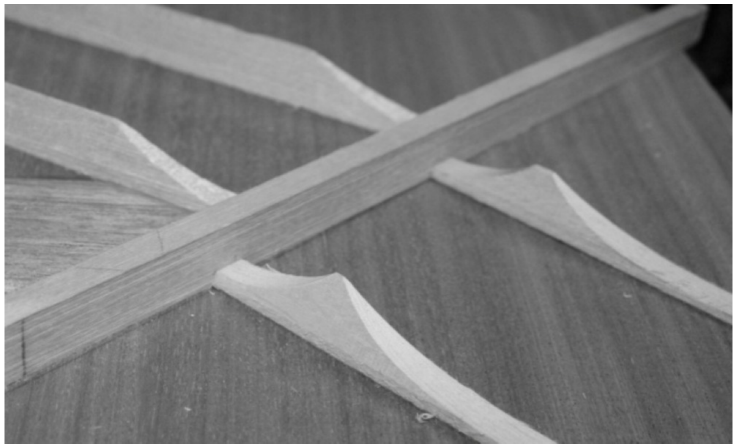
KEEPING THE BRACES IN PLACE

Guitar braces go through a lot of stress while the guitar is resting, and a good deal more while being played. It is a good idea to do whatever is possible in order to keep the braces in place for the lifetime of the instrument. There are a few things worth mentioning that will keep the braces sticking to the guitar for a long time. The most basic of these is having a good glue surface to start with.

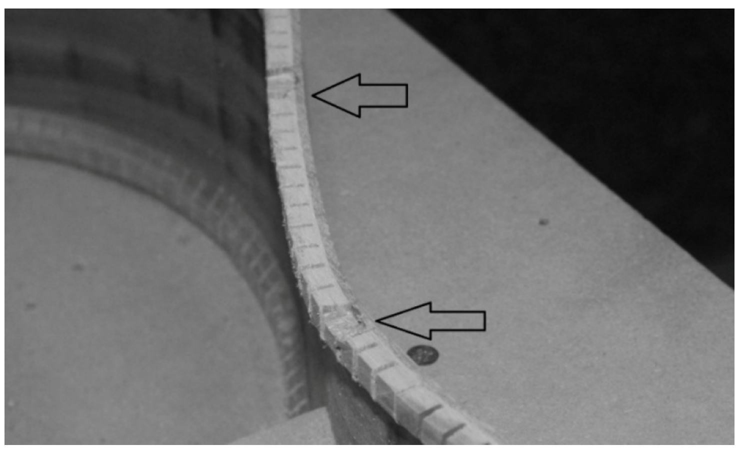
A good flat gluing surface is a must for getting the best adhesion between the braces and the top. If at all possible, run the brace blank through a thickness planer while it is still one solid piece. This will ensure that the faces are true and flat. Since the bracing blanks are usually not very wide, a jointer can be used for the same purpose. If neither is available, lay a whole sheet of 220 sandpaper on a flat surface, and work the brace blank until the face for gluing is totally flat.

Good clamping pressure is also important when gluing the braces in place. Coat the brace well with a good quality glue, and place it on the guitar top where it will be glued. Press the piece down and work it back and forth a little bit to spread out the glue and make sure the joint is completely covered. Clamp the joint with good pressure so that a little of the glue squeezes out around the foot of the brace. Glue squeeze out is actually a good thing, because it means the entire mating surface has been covered.

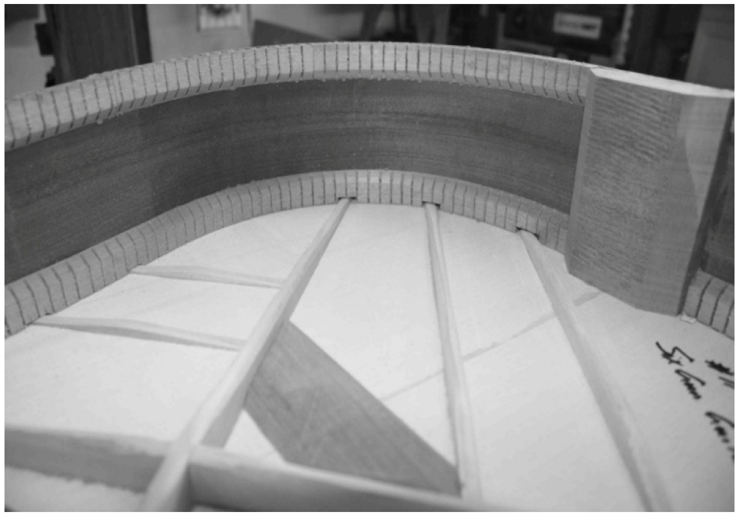
Another good way to keep the braces in place is to interlock them, and let them all use each other for support. Each brace can have another that holds it down, and eventually every brace will have something holding it in place.



The finger braces in the above picture are notched into the x-brace by about 1/8", which is just enough to hold their ends in place. The lower tone bars on the other side are notched under as well. The notching is easily done with a small sharp chisel.



To trap the ends of the larger braces like the x-brace, upper face brace, and lower tone bars, they will need to be notched under the kerfing. The best way to do this is to line up the waist and the top and clamp it in place. Mark the locations where the braces contact the rim using a pencil, and chisel them out. A Dremel tool and a router base really make this a quick job, but a chisel does it fast as well. Make sure to resist the urge to brace the sides with the free hand while using the chisel. Hold a piece of wood against the side while pressing with the chisel so that if a miss happens, it hits the wood and not the hand. There is no way to react fast enough if the chisel slips. Ask me how I know.

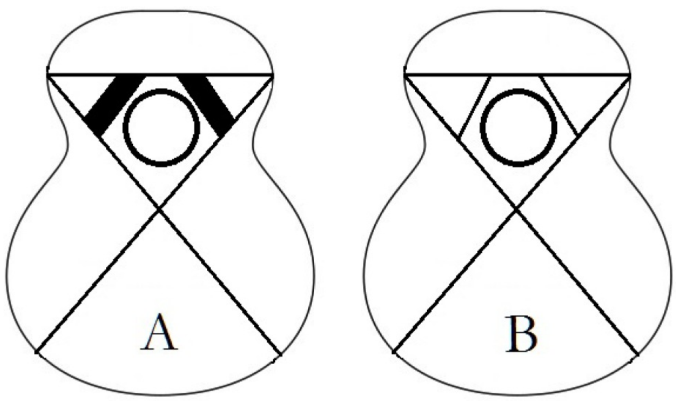


Test fit the top on the sides again and check that all the brace ends go under the kerfing nicely, and that the top can be clamped flush against the sides. Sometimes the bracing notches need to be made a little deeper if the braces prevent the top from sitting flush against the sides, but make sure not to take more than is needed for a nice fit. Too much wood removal will result in the kerfing not holding the brace at all, which does not accomplish anything.

Every brace has the ability to be held down by either the kerfing or another brace, which means the braces will not be coming off the guitar any time soon.

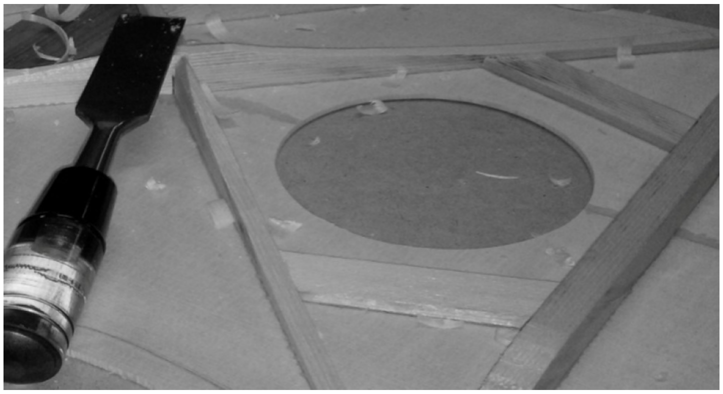
SOUND HOLE BRACING

The area around the sound hole on a guitar is especially vulnerable to the loss of vibrations as they move along the top. There are a number of things that can be done to improve the transfer of these vibrations around the hole instead of off into the air, and any of them will help make an improvement on the instrument.

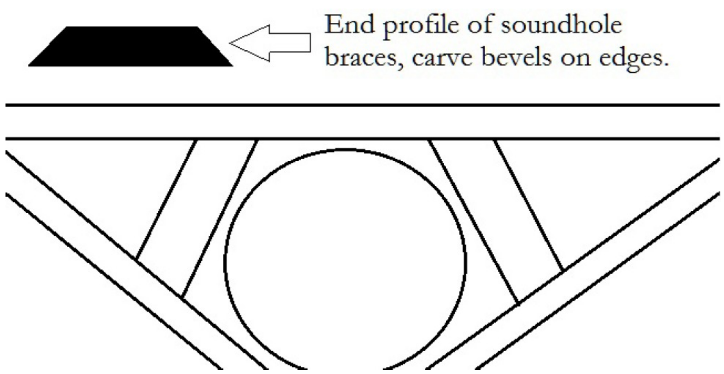


The guitar top on the right has what would be considered standard bracing around the sound hole. There are two small braces, about half the height of the main braces, and a little thinner. They serve to strengthen the area around the sound hole, however they do not do very much more than that.

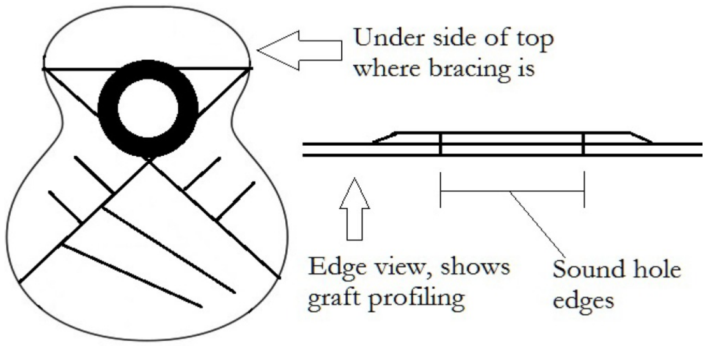
Top A on the left has a wider and thinner brace, however it is laid down flat. This increases the mass around the sound hole and gives a comparable amount of strength as the braces in example B. The advantage to bracing A is that the extra mass gives the vibrations more of a chance to pass through the wood rather than drop off into the air. The sound hole section retains more vibrational energy with the extra mass to protect this normally thin area.



The picture above shows how the braces look on a top that is in the process of being carved. The braces themselves are 3/16" thick and 1" wide. They are fitted into the area around the sound hole by marking the center of the top brace and spacing them evenly on each side of it. This will make an even looking bracing pattern, and give the best placement.



After the braces are cut and glued into position, they will need to have their edges beveled like the image above. This is sometimes hard with the other braces in the way, and can result in gouges in the x-brace as well as the upper brace. It is not a bad idea to carve the bevel using a sanding block or a belt sander before gluing them in place. This way there is no need for further carving, and there will not be any extra dings on the main braces.



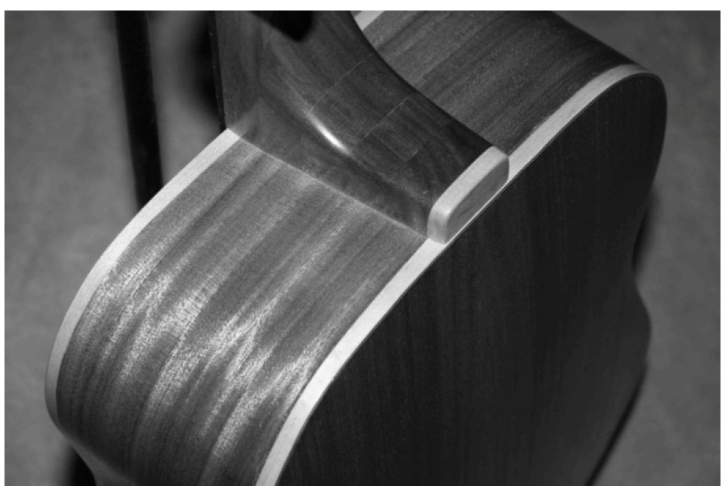
Another way the sound hole area can be reinforced and made to work better is by using a piece of spruce top material to thicken the immediate area. This does require a large piece of spruce, but a spare and inexpensive top can provide several, if only used for this purpose.

The above image on the left shows a view from under the top, and the black ring is the approximate location of the sound hole graft. The piece of spruce is cut about 1" larger in diameter than the soundhole, and glued in place under the top before the soundhole is actually cut out. The edges are beveled downwards like in the above picture on the right, and the soundhole is cut through both. The insides can also be beveled back a bit to make the top not look as thick in that area, removing wood from the inside of the sound box only. Where the x-brace and upper brace intersect the graft, it will need to be chiseled down to the original soundboard height to allow them to pass through.

SOUNDBOX VOLUME

The amount of air inside the body of the acoustic guitar will influence the tone as well as the effective range of the instrument. Looking at acoustic guitars in general, certain styles have similar air volumes in their bodies, and it is like that for a very good reason. Lighter and more jazzy guitars that rely on higher notes and tilt a little towards the brighter side, will generally have lower air volumes. The middle of the road guitars like the orchestra models will play evenly across the bass as well as the treble sides, and have medium sized sound boxes. The powerful bass and punch that comes from a dreadnought guitar, comes in part from the larger air volume.

Generally speaking, thinner guitars with smaller air volumes in their sound boxes will have brighter tones in the upper registers, and weaker tones in the bass. The other side of that coin being larger guitars with larger air volumes will have stronger bass, with not as much control over the high notes. This can be worked to the advantage of the guitar maker, and used to create a guitar that plays the most in line with what a person likes to hear.

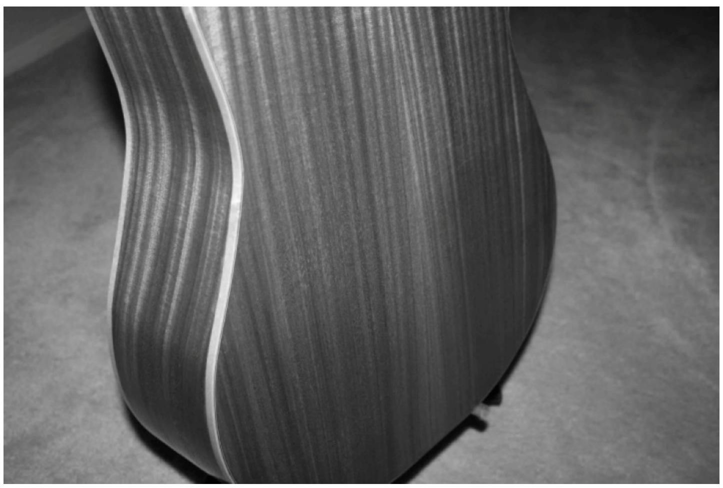


In my case, I like a dreadnought guitar to have a powerful bass sound, and a hard hitting punch that can be felt when the instrument is played. The guitars I enjoy building deliver more sound than they look like

they should, and it is because of little changes that are made to the standard structure. With dreadnoughts especially, the real joy and expression that comes from them comes from the lower frets and from playing chords. This plays hand in hand with having a larger sound box because it will increase those attributes.

The thickness of the sides at the neck position on the above guitar are almost the same as the lower bout thickness of some orchestra model guitars. The lower bout is over 5" deep, which is a bit larger again than most acoustics. These small changes do not seem like much, however they do increase the air volume inside significantly.

Another way to add volume to the inside of the box is to curve the braces a little harder, doming the back plate more. This can add a really neat effect to the back of the guitar as well, making it look more domed and almost as if it were carved from a thicker piece of wood.



The doming of the back can be seen in the above photograph, as well as the extra bulk on the lower end of the sound box. The center is almost 1/2" higher than the edges of the plate, which is a significant bend. These changes to the way the guitar is made give a punch and a growl to a guitar that really lets the bass come through.

Try increasing the soundbox size by a quarter inch at the top and half an inch at the bottom and see how the bass changes. If the effect enhances the overall tone, try doming the back plate a little more on the next guitar.

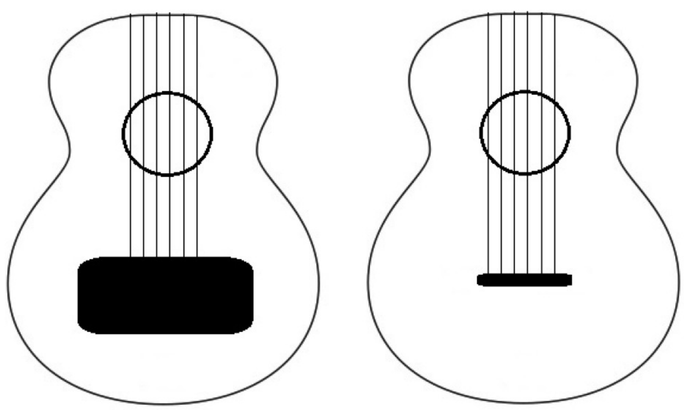
The trick is to add size but not make a guitar that takes someone with 4 foot long arms to play. If the guitar cannot be held comfortably, it will not be played very often. A trick to keeping the size manageable and yet increasing the air volume is to increase the depth of the box at the bottom by the same amount the both were to be raised.

In the above example, 1/4" at the top plus 1/2" at the bottom would come to 3/4". Raise the thickness at the bottom by 3/4" and keep the neck area the same size. This way the slope of the back as it bends from the end pin area to the neck area will feel about the same as if it were a regular sized guitar. The area that contacts the body is near the neck area anyway, so the very slight increase in size will not be noticed. The larger lower bout and tail section will be sticking out past the arm and not be in the way as it helps push more bass and chunkier sound from the guitar.

BRIDGE AND BRIDGE PATCH

There are a few more items that have enough of an effect on the tone of the instrument that they are worth mentioning here as well. The size and location of the bridge, the size of the bridge patch, and the size of the soundhole all influence the sound and tone produced by an acoustic guitar.

The bridge on the guitar must be big enough to hold the strings in place on the guitar and transmit vibrations through the top, but small enough that it does not dampen the vibrations. However, it cannot be so small that it offers no support, which over time will damage the top.

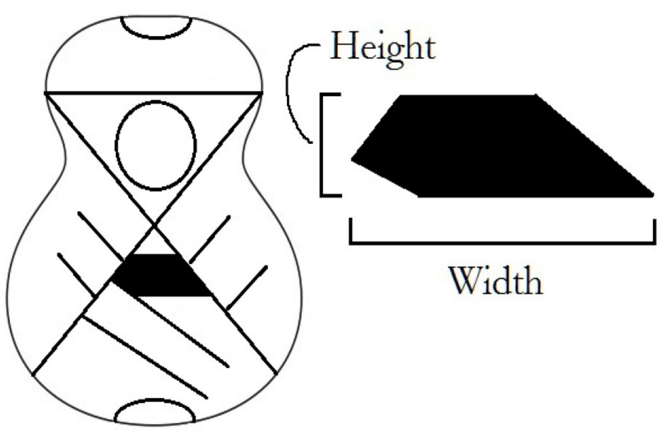


The two guitars in the above diagram represent two extremes in bridge sizing. The guitar on the left has a monster of a bridge, at least four times the standard size. This bridge will have the effect of reducing the ability of the top to vibrate when the string is played, making the sound very poor. The guitar on the right has a bridge that can barely hold the saddle and the bridge pins, and in real life would most likely have ripped off by now. In the theoretical world however, it would most likely sound great when played because the small size allows more vibration to occur at the bridge area. The problem with the bridge on the right is that it does not have enough mass to withstand the pull of the strings. Yes, the strings are pulling from the bottom bridge patch area, but they are also putting a forward force on the bridge, which needs enough mass and gluing area to keep it held down despite those forces.

Again, a compromise must be made between stability and sound, which the standard size bridge does well. Taking this bridge size and making it a little narrower from the saddle to the bridge pins can increase the vibration of the top, but not be too detrimental to the structure of the guitar.

Another factor that goes along with the bridge size is the size of the bridge patch on the underside of the top. The purpose of this piece is to be a hard layer that the ball ends of the strings can rest against, as well as spread out the force of the strings pulling against the top. The first reason is easy enough to understand because spruce is relatively soft, and the harder rosewoods and maples can resist wear for longer. The second trait is to link a larger portion of the sound board to the bridge, so the strings end up pulling on a larger area.

For the same reason as before, an overly large patch will dampen rather than encourage vibration, and a very small patch will reduce the structure, and also to some effect the sound. A bridge patch that is just slightly larger (saddle to bridge pins) than the bridge by about 1/8" on each side is perfect. It should go all the way from the x-brace and lower face brace legs on the left, to the x-brace leg on the right. This distance is fixed by the location of the braces, and the height again is determined by the size of the bridge.



The diagram shows the location of the bridge patch and how it is generally shaped to fit inside the braces under the top. The distance from top to bottom, or the height in this case should be 1/8" larger on both sides

than the bridge being used on the guitar. Those ends should also be beveled down so they meet the sound board flush.

The width of the patch is determined by the placement of the braces. Narrower spacing of the braces will result in a narrower bridge patch. The left and right edges should not be beveled at all, instead they should contact the braces snugly. The patch should be about 1/8" thick or slightly thicker, but not too much more because the added weight will dampen the top vibration.

Once the piece is cut and ready to be glued in place, make sure there is no dried glue at the base of the braces where they meet the soundboard. This can cause the patch not to seat well, and reduce its effectiveness overall. Gaps under the patch can also buzz over time, and dampen vibrations. The snug fit against the x-brace legs ensures that vibrations and energy are sent through those braces as well.

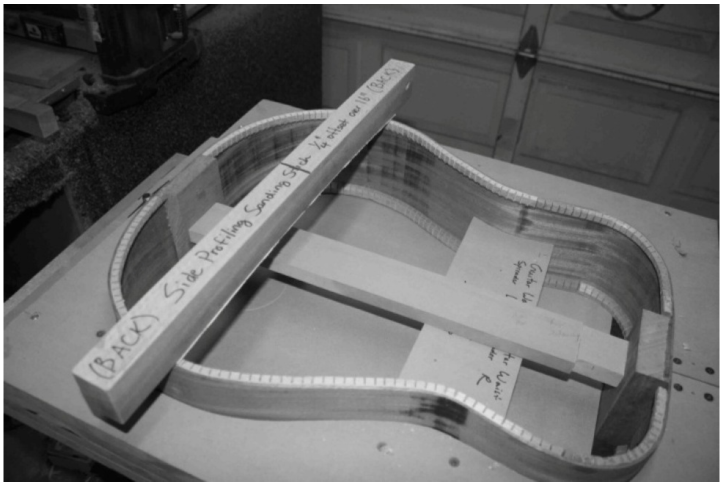
DOMING THE PLATES

The back plate and the top plate are slightly domed or arched with the braces so that a stronger and more resonant guitar is made. The dome on the top acts almost like the cone of a speaker, flexing up and down as the strings vibrate. Doming this structure allows this flexing to happen more than if it were totally flat.

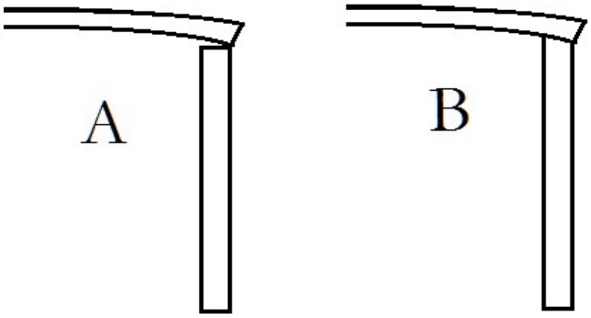
The dome on the back is so the harder wood acts as more of a baffle, catching the sound and directing it back at the top where it can cause further vibrations to occur. Another purpose of the dome on the back is that it is a better structure than a flat back for the overall stability of the guitar. Finally, having a completely flat back will actually look a little bit caved in rather than flat, which is not a good look at all.

The only issue with making domed plates is the sides of the guitar will no longer line up really nice for gluing. If the top and back were flat, the sides would meet at a 90 degree angle, and the joint would be a very straight forward glue up. However, now that the joint is off by a few degrees, the joint will not be as good.

Forcing the joint into place is a bad idea for several reasons. First of all, the stress over time can cause the plates to come loose, binding to come apart along the seams, and braces to fall off. The top especially can be forced flat again which ruins the dome and the whole point of making it. Lastly, the domes were created for a reason, and they should be retained as they were designed.



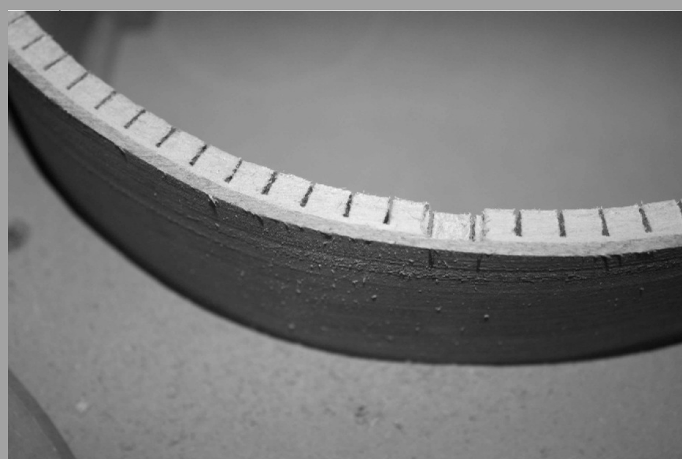
A simple sanding stick can be made from the instructions in chapter two, that will put a small bevel on the edges of the sides and the kerfing, where they meet the plates. This small difference in the shape of the joint will make a huge difference in how easy it is to glue everything together. Plus, it will only take a few minutes of sanding to create the perfect bevel, since the profile on the sanding stick is a dead match for the arch of the bracing.



The above picture shows how this looks in a slightly exaggerated form. The side is the vertical piece and the plate is the horizontal piece. Guitar A has a side without a bevel, and the curved plate meeting it, as if it were about to be glued together. The gap can easily be seen where the plate does not quite make contact with the side. Either it will have to be forced into place through excessive clamping pressure, or it will be glued with a poorly mating joint.

Example B shows the side having been beveled a little with a sanding stick, so it matches the underside profile of the plate. Now the match is perfect and the glue joint that will result will also be perfect. No extra pressure will be needed, and there should be no gaps in the final joint either.

Project Notes:

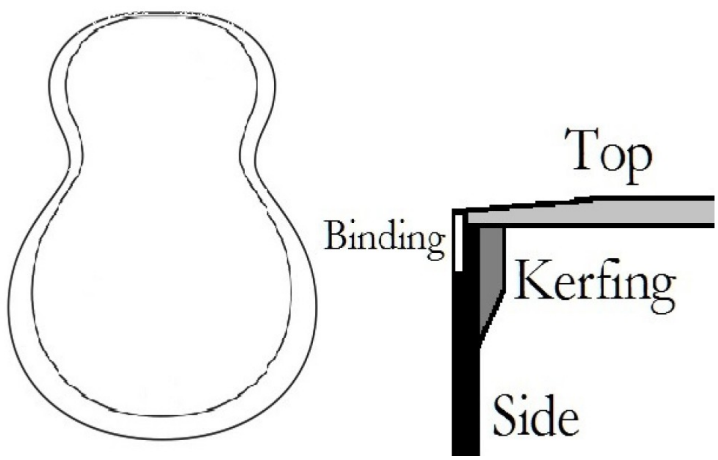


A good way to tell if the sanding is completed is to mark the edges with pencil. Once the pencil marks are gone from all the edges, the bevel should be pretty close. Mark again and remove the marks with the curved sanding stick and the bevel should be correct. Test fit the plate, then glue.

BEVELING THE RIM

The way an acoustic guitar makes sound is mainly by the top plate flexing up and down from the changes in tension that come from the string being played. This flexing needs to be encouraged in every possible way, which will result in a better sounding instrument. A step can be taken near the finishing of the box, where the edges are beveled slightly to reduce the amount of wood in that area.

The effect of beveling the edges will make the plate more flexible around the rim, making it more able to move with the vibration of the strings. More vibration and less resistance to the force of the strings means more sound and better sound.



The above diagram shows how the rim will look once it has been thinned. The guitar profile on the left shows a double line where the thinning takes place, and it goes deeper in certain locations than others. The lower bout gets thinned much deeper than the rest of the guitar, because this is where the majority of the sound comes from on the plate. This thinning can go out as far as 2" if desired, though 1" of thinning will work as well.

At the top where the neck attaches, there is no thinning at all, because it will interfere with the neck joining and make it look sloppy. Also, the upper bout area near the neck joint is fairly inactive acoustically, so the extra bulk will not really affect anything. There is also less thinning

around the waist area, and this is due to the fact that there is already not much bracing in that area, and therefore will move enough on its own. It still gets some attention, but not to the extent that the lower bout is beveled.

The beveling gets larger again near the outsides of the upper bout, which loosens up the area around the upper brace and the top arms of the x-brace. This encourages better vibration, and does not weaken the structure enough that it will cause any problems.

The image on the right in the diagram shows a close up of what the top, sides, kerfing, and binding would look like having been thinned in that area. The top is where all the material is removed from, and the total thickness is taken down to half the original soundboard thickness at the very end. This slowly floats back up to full thickness where the bevel stops, and is very gradual. The total amount of wood being removed at the edge where the binding is would be around 1/16" or less, so the bevel will be barely visible after blending and sanding.

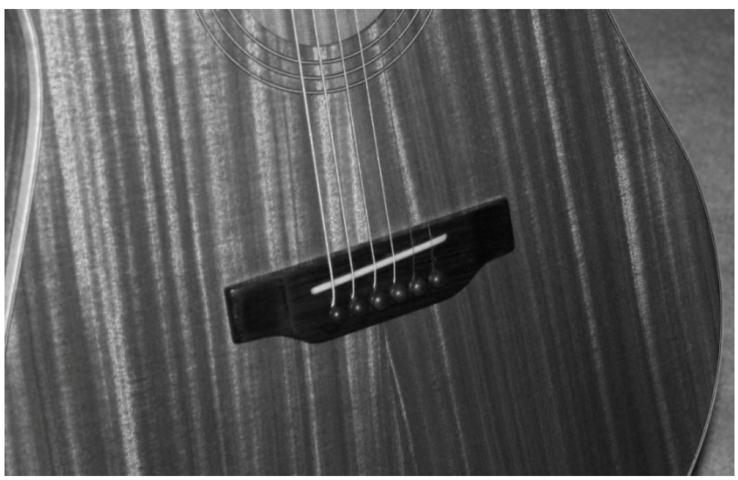
A consideration that needs to be mentioned is the effect of the beveling on the binding strips and the purfling. The binding strips may need to be laid a little deeper than normal to accommodate for the 1/32" to 1/16" of height being removed during the beveling. The purfling must also be laid a little deeper so that it does not end up being sanded completely through. The guitar can also be bound after the beveling process has been done, but it will be more difficult to get a straight cut with the router now that the top is carved. A binding jig with a guide for the side of the guitar rather than the top will work better if binding after the beveling.

Knowing that the bevel will remove a little binding, simply rout the binding shelf a little lower to compensate, and glue it on as normal. Having the binding in place while scraping and sanding gives a visual line that can help show uneven spots that need more sanding. The binding does not need to be laid deeper if that is not desired. The thinner looking strips that result sometimes have a really nice look on the guitar, which is different than the normal size of binding.

The binding in this picture was laid in a little deeper than normal to compensate for the bevel around the edge. It looks nice and proportional, and still serves the function of making the guitar look nicer, as well as covering the joint. The bevel around this rim extends inwards about 2" from the edge, and blends really nicely into the top itself. The guitar sounds great too.

BUILDING NECKS FOR SOUND

The neck and the bridge are very important for the transmission of energy from the strings to the sound board. The bridge is pulled tight by the tension of the strings on one side, and the neck holds the other half of the tension on the other. Both of them suffer at the hands of the other, because they share equally in the responsibilities of keeping the strings in check. If the bridge were to be loose fitting or of poor construction, the neck would not have something strong to pull against. Likewise, if the neck is thin and of poor quality, the bridge would have a hard time pulling on it. The way to ensure a good strong sound from an acoustic guitar is to pay attention to what happens at the neck and bridge locations.

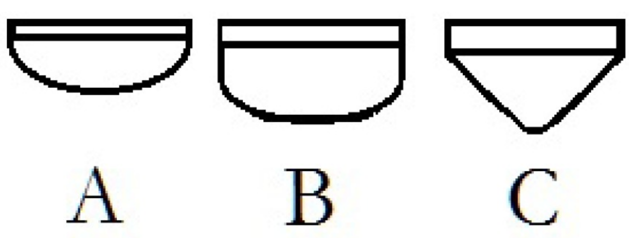


The bridge needs to be glued in place as solidly as possible and with the best quality glue available. This is no area to skimp on preparation. The bridge and the top must have the same profile on the mating surfaces, meaning the curved top must meet a curved bridge and a flat top must meet a flat bridge. The flat tops are pretty straight forward. Make sure the bridge blank is planed flat before shaping it, and it will glue perfectly to the flat top. For a slightly arched top, lay a piece of 100 grit sandpaper face up on the guitar where the bridge will be, and rub the bridge back and forth until it is a smooth joint. Check the work from time to time by removing the

sandpaper, blowing off all the particles, and testing the fit. Once it is a good match, finish with some 220 to smooth out the rough spots on the bottom of the bridge, then it is ready to glue.

When confident that the bridge is not going to be a problem in the bridge/neck equation, it is time to move onto the neck. This is where the ability to make some effective changes really takes place, and a compromise between toughness and playability will have to be found.

The neck on the above guitar was made from two pieces of Goncalo Alves with a piece of Indian Rosewood sandwiched between them. The truss rod is a heavy steel bar that is bent over on itself, and the heel is massive. The profile of the neck is closer to a D shape, which means it is a lot to hold onto. All that being said, this guitar plays like a dream because the neck is very solid and has some weight to it. The vibrations that are normally lost to a regular or small neck are kept longer, which means a fuller and thicker sound.



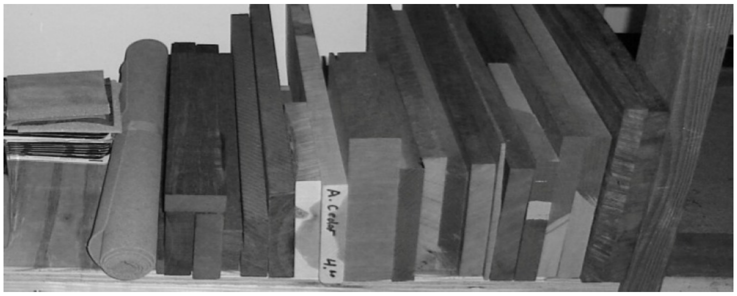
The above diagram shows three common neck shapes, as if the neck were sliced in half and we were looking at the end. Neck A is very common on electric guitars. It is thin, light, and easy to move around while playing. It lacks the bulk to really help with the loss of vibration through the neck, but since electric guitars have the advantage of amplification, it is not really an issue. Neck B is a bulky D shaped neck, and is shown a little exaggerated in the diagram. The extra mass of the neck helps keep the vibrational energy in the instrument, but does make it a little harder to grip. For most people, a larger neck is something that can be played with a little getting used to, and acoustic players are not normally flying around the neck doing solos anyway. Shape C adds strength with the taller piece of wood, however there is not much bulk, which ends up not retaining as much vibration energy as the thicker D shaped neck.

The compromise that needs to be discovered is between making a very thick and heavy neck that is almost unplayable, and fairy wand of a neck that is super easy to play but can barely hold the string tension. The middle really depends on what kind of a player will be the end user of the guitar. Either way, there are a few tricks to helping keep the vibration in the instrument while not having to explain to people why the neck is so huge.

The simple addition of a strip of dense hard wood down the center of the neck can make a big difference in how it plays. The strip will add a little weight, but it will stiffen the neck, add mass, and help control the vibrational energy coming from the strings. The above neck was

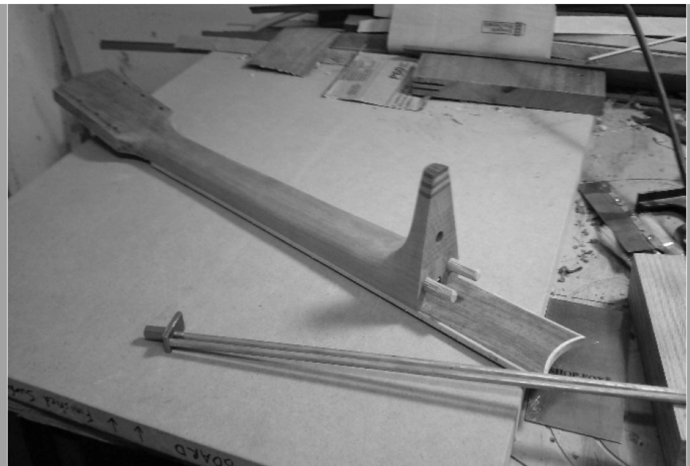
stiffened with a piece of Indian Rosewood that goes from the heel all the way through the headstock. Not only does it add a nice visual touch, but it also adds some strength and bulk.

Another way to add some mass is to use a denser piece of wood for the neck. Mahogany has long been the mainstay for guitar necks, but there are so many more options out there that will not only work well, but also help the sustain of the instrument. The standard next level for neck making is Indian Rosewood, but other species like Goncalo Alves, Hard Maple, Brazilian Cherry, and Peruvian Walnut make excellent necks too. Almost any species that has the hardness and density of Rosewood or better can be made into a fine quality neck that will add mass for greater power and sustain.



The best way to reach the compromise between mass and playability is to craft a neck from a slightly denser wood like Rosewood or Goncalo Alves and also carve the neck a little larger than normal. Test the neck on the guitar for a few months, and if it is too much to play it can always be carved back a little bit. Wood can always be removed, it cannot be put back, so carve off a little mass, and then re-finish the neck if needed.

Project Notes:

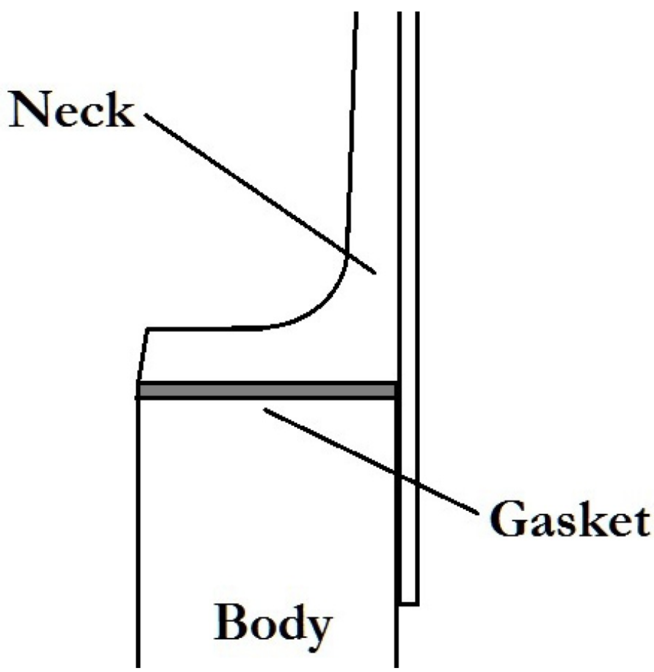


This is one of my larger necks, carved to a D shape and ready to be installed. The base of the neck retains a lot of the bulk and size, keeping it closer to the body for balance. The peg head end tapers a little bit but still remains slightly larger than the standard neck. This is for an adult with larger hands, so the extra bulk will not be felt.

The above image is one of my thinner necks, made especially for a young player. The neck was carved extremely thin to help the smaller hands of a child get around to the frets nicely. The compromise I made here was to use a very dense species of wood for the fretboard, which adds the mass and still allows the playability I was looking for from the instrument.

NECK TO BODY JOINT

The joint between the neck and the body is one of the most important connections to be made on the entire guitar. This joint is responsible for keeping the neck stable during playing, and it helps control vibration loss from the neck. Having a very strong neck to body joint will stiffen the overall structure, and allow the whole instrument to vibrate better. This will result in better sound, longer sustain, and an overall better playing instrument.

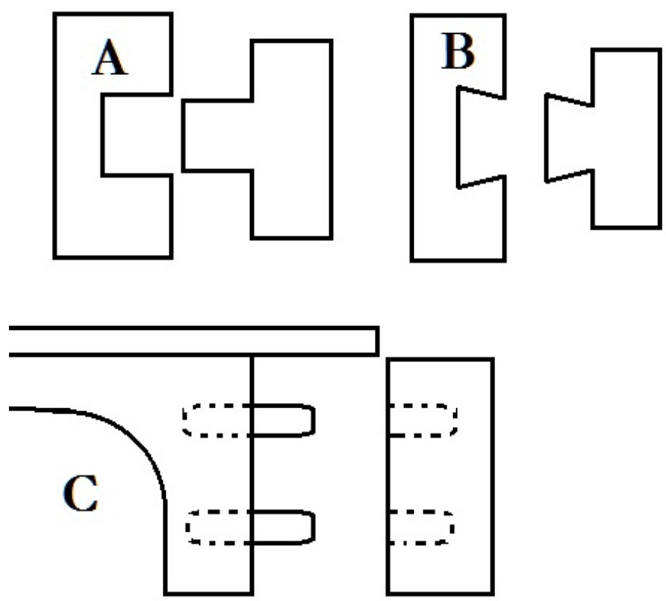


The importance of the joint between the neck and body can be illustrated in the above diagram where a rubber gasket has been inserted between the two pieces. This gasket simulates a badly joined neck, in the sense that it dampens vibration, and makes the neck less stiff. A neck that is wobbly and not rigid makes a poor conductor of vibrations, and a poor sounding guitar results.

As the string is played, the vibrations are transferred to the guitar top, however the rubber gasket eats up the majority of the force,

causing barely anything to emerge from the guitar as sound. A poorly constructed joint that allows the neck to move around while the strings are played has the exact same effect, and reduces the power of the guitar.

If the rubber gasket were removed, it is easy to imagine how much better the sound would be, because the dampening effect is gone. This makes for better transfer of vibration, and better sound from those vibrations. The structure would not be prohibiting the very thing we are trying to maximize in guitar construction. Vibration equals sound, which means if vibration is maximized, sound will be maximized as well.



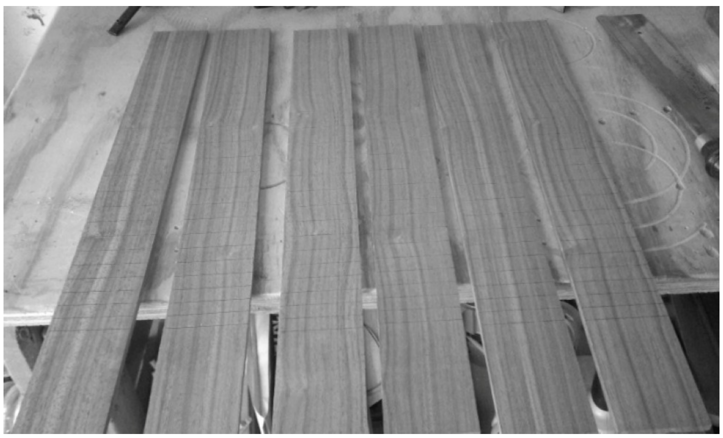
There are several ways to join the neck and the body, and they all have one major thing in common. They all join the head block of the body and the end of the neck with some sort of wood piece between them. This can be a tenon of wood in example A, where the head block is on the left and the neck on the right. Or it can be a dovetail (which is still a type of tenon) in example B, where the head block is also on the left and the neck is on the right.

Example C shows a floating tenon design, where two large dowels are used to secure the head block and the neck together. This is still one of the strongest joints in woodworking, and an easier way to connect the neck and body than a tenon or dovetail.

No matter which style of joint is constructed, as long as the head block and the neck are joined together with some piece of connecting wood, it will make a good joint. These pieces will lock together better, hold better, and less vibration will be lost while playing.

MAKING A CUSTOM SCALE LENGTH

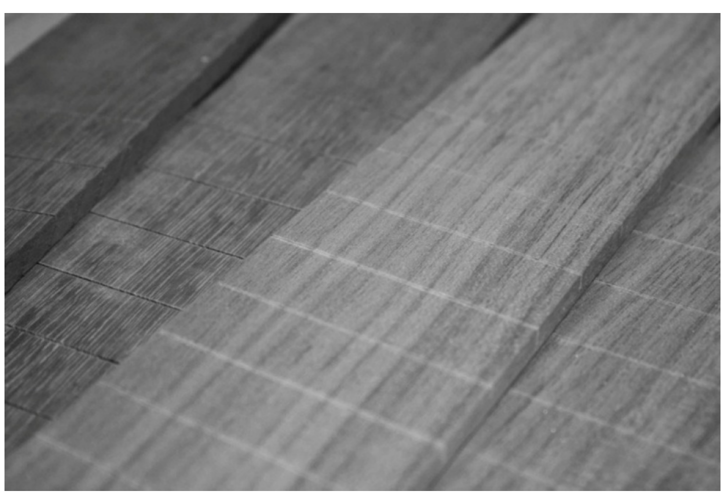
Every major manufacturer of guitars has their own scale length that is associated with their brand, and they each have their own reasons for it. A custom scale length is an interesting step in guitar making, and requires much thought before trying it out.



Martin guitars have for the longest time, had a scale length of 25.34" from the nut to the saddle on their acoustic guitars. Gibson uses a 25.625" scale, and Fender electrics use a 25.5" scale. All of these manufacturers have claims about their scale length doing something or another to affect the sound and playability of their instruments. However, there is only one really important thing to know.

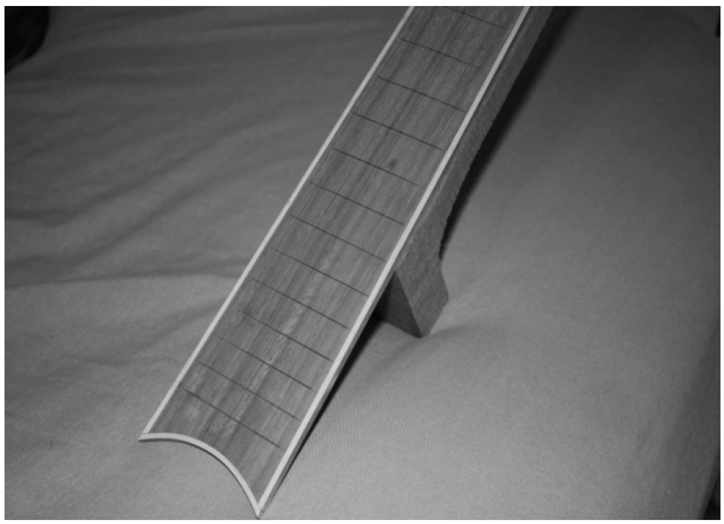
When a scale length is longer, making the string length longer when playing, the string itself will have to be tensioned harder than on a shorter scale length. Think of playing a guitar while holding the low E string on the third fret. The note being played is a G, and this is because the new length of the string is shorter than it would be if played open. To get the open string to play a G, it will need to be tightened much more to raise the pitch.

The same would go for the opposite effect on the low E string. If the scale length were much shorter, making it only as long as from the third fret to the saddle, the string would have to be loosened in order to drop the pitch at the third fret to the low E that is normally played with an open string. In the first case, the string would be so tight that it would not be comfortable to play, and in the second it would be too limp to vibrate and sound well.



Knowing that longer scale lengths require higher string tensions, and shorter scales require less string tension, the other thing to deal with is the thickness of the strings themselves.

On the same guitar with the same scale length and tension, a thicker string will vibrate with a lower tone than a thinner one will. This is true for wound strings and plain strings. The thicker the string, the lower the pitch it will produce. This property can be taken advantage of when designing a custom scale as well.



Since longer scale lengths need more tension, and thinner strings vibrate at higher frequencies, using thinner strings on a longer scale can compensate for having the longer scale. Also, on a shorter scale where the strings might be too loose to vibrate well, using a thicker set of strings will help get them tighter while making the same note.

Do not deviate too far from the standard scale lengths created by the master guitar makers, unless in the mood for some serious experimentation with the guitar itself. Strings can only compensate for so much when the scale length is changed drastically longer or shorter, and a completely unplayable guitar may result.

In general terms, a shorter scale length will feel softer on the fingers than a longer scale length with the same strings. Most electric guitars have shorter scale lengths than acoustics, which allows for thinner strings and easier bends. On an electric, tension of the strings does not matter as much, because there will be an amplifier to increase the output

and volume. On an acoustic, there needs to be enough tension to vibrate the soundboard well, so a super short scale length is out of the question.

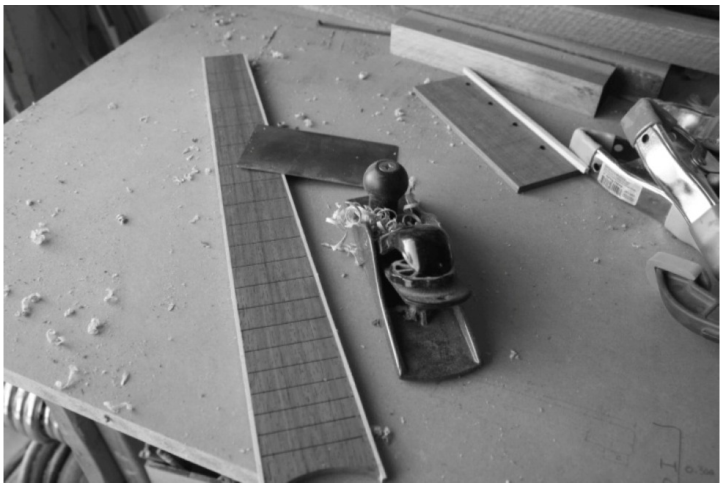
To create a custom scale length, a little math is required. To create the fret positions that are used on guitars, each fret is a derivative of the scale length divided by 17.817, which is called the rule of 18. This method will place the 12th fret in the middle of the scale, which is where the octave is.

Start with a presumed scale length of 25.25" for example, which is definitely on the shorter side when compared to other popular acoustic guitar scale lengths. Divide 25.25" by 17.817, and the result is 1.417", which is the distance from the nut that the first fret will need to be. Take the first fret distance of 1.417" and subtract it from the original scale length of 25.25" and the result is 23.833". To get the second fret position, divide that number by 17.817 again, and it will give the next distance, which is 1.338". Repeat this until all the fret positions are calculated up to 24 or whichever number of frets is needed.

If this looks like too much math, there are several online fret location calculators that can do the work with a few mouse clicks. They have areas where a scale length can be plugged into the formula, and the computer will generate all the fret locations instantly. At that point they can be printed out or written down and used to cut the fret slots.

When it comes to measuring the fret locations out, it is advantageous to do it a little differently than by measuring from the

previous fret as the math would indicate. Take the distance for the first fret and write it on the top of a piece of paper. This is the true location of the first fret, written as the distance from the nut. Measure 1.417" from the nut, and the first fret goes there. For the second fret, add the distances for the first and the second fret together, which in this case would be 2.755" and this would be the distance from the nut that the second fret should be placed.



Repeat the above procedure adding the next fret location to the previous total, and soon there will be a list that shows all the fret locations as a distance from the nut. Measuring from the nut every time decreases the chances for a misplaced fret. It also does not allow a small mistake on measurement to be compounded by each additional fret.

For example, if we were measuring from fret to fret, and the third fret was a little too far from the second fret, every other fret will also be a little too far away. Measuring fret to fret means a mistake on an earlier fret keeps getting carried further and further down the line, making everything wrong. Measuring from the nut ensures that if a small mistake happens it will be noticed, and the board discarded.

After all the numbers have been figured out, measure the locations for the frets and draw a small line where they need to go. Using a square, extend this line across the width of the fretboard. Carefully, and using a small block as a guide, saw the slots into the board.

After a master board has been made and thoroughly checked for accuracy, it can be used with the fretboard duplicator jig that is described in

chapter two, to make dozens of copies. This way the painful and nerve wracking task of measuring and cutting each fret by hand can be avoided.

BUYING WOOD

When buying wood for a guitar, there are a few things to pay attention to that will help make guitar building easier down the road. Buying wood in person, and buying wood that has already been dried are two important details that make a big difference in what ends up in the shop.

It cannot be stressed enough that buying wood from a catalog or online should be the last resort. If the piece of wood cannot be found in a hardwood store and there is no other place to walk in and buy it, then a very reputable online retailer is the next best thing. The reason to buy as much wood as possible from a walk in retail environment is that it can be handled and looked over prior to purchasing. Online places show one picture for the thousands of boards they sell, and it can be guaranteed that the set in the pictures is long gone. It is essentially buying an item sight-un-seen. For this reason, only purchase from well known dealers that have a reputation for excellent wood quality. Stewart MacDonald and Luthiers Mercantile are two such places.

A hardwood store will have many pieces of the same board, and they can be looked through to determine which one will look the best for the particular use.

The next thing to look for when selecting wood from a hardwood store, is whether or not the wood has been dried, and how long it has been in the store. In most larger operations, the wood has all been kiln dried to a low moisture content, and has been stacked together into a large bundle. Wood that has been in the store a long time is also better because it will have had even more time to adjust to the humidity in the area.

The reason to look for already stable boards is so they can be used to make a guitar right away. Having a place to season wood in the shop is a luxury that most guitar makers do not have. Also, many pieces need to be purchased a long time in advance and left alone forever before being used. Not many hobby luthiers have the money or space to buy up a room full of wood and just watch it do nothing for several years. Buying already stable wood means being able to make guitars immediately.

The final thing to look for, which is really more of a warning than anything, is that price does not necessarily mean quality. Many times price actually means more about rarity than quality. A hard to come by piece will always cost more than common piece of equal quality. Brazilian Rosewood and Koa are two examples of woods that are expensive due to scarcity more than quality. They are both great pieces of wood to work with, and both make great looking guitars, but there are several substitutes for either that will sound about the same and look about the same.

The piece of wood in the above picture is a straight grained, excellent quality piece of Padauk, that has the most amazing depth of color I have ever seen in a back piece. The board would have been far more expensive had it been ordered online, and possibly not look as good. The board was found as a cut off laying on a shelf, for 1/5 the online price. All I had to do was split it open and plane it flat. Money does not mean everything with wood, and it is always better to buy something that looks good rather than something expensive.

MASTER GRADE WOOD

Wood can look very different from piece to piece and place to place, so a grading system was needed to make sense of it all. Unfortunately, there is not a uniform system that everyone uses, rather the final sellers grade their wood according to what they think it looks like. This is not necessarily a bad thing, but it is worth looking up the grading system of the place where the wood is being bought. This way the same quality of board can be purchased from any retailer.

Depending on where the wood is being purchased, a retailer may have a complex grading system with several levels of quality. They may account for grain lines, straightness, coloring, and other factors in their decision. On the other side of that coin, the retailer may only have a few grades or no grading system at all. Either way, spend some time getting to know what kind of wood a place sells before buying anything too expensive. Besides, the grade refers to the looks more than anything.

The grade given to a piece of wood has nothing to do with how a piece of wood is going to sound when made into an instrument. There is no way to know that for certain based simply on how a piece looks. The grading will be on cosmetics like the evenness of the coloring. Higher grades will have uniform coloring where lower grades can have very

different shades of color on the same board. The straightness of the grain and the tightness of the lines are also graded. Tight grained and even grained woods look nicer, sell higher, and receive better grades. The lower end pieces may have some places where the grain is tighter and some where it is wider, or it may not run completely straight from end to end. Again, these items have so little an effect on the tone of an instrument when compared with how the instrument was made.

The guitar on the left has a nice straight grained back, with grain lines that run from the top to the bottom with almost a rulers accuracy. However, the coloring is lighter and darker in some places, which would make this an average quality board. The guitar however does not sound average at all. This is where the grading system sometimes gets new guitar builders thinking too much.

For the longest time the tops I used were second grade quality. In the grading system they use, this refers to the lowest level, and therefore the least expensive of their wood. However, since the grading refers to the looks and not the performance, I used them for a long time. The guitars that were made sounded no differently than the few I made with master grade wood, and some even sounded better. It is not the wood that makes a guitar great it is the maker. Good wood will look nice, but any piece of wood can be made into a great sounding instrument in the right hands.

Taylor guitars demonstrated this in an excellent fashion with their Pallet guitars. They set out to prove that the wood matters little when compared to the maker, and that just about any piece can be made into a good sounding guitar. The builders took pieces of wood off of the pallets that were used to ship them their expensive tone wood, and they made a set of 25 acoustic guitars from them. The backs and sides have nail holes, oil stains, and the worst grain patterns ever seen on an instrument. The tops are made from several sections laminated together, and they may not even all be the same species. With all of that going against them, the guitars sounded great. Proof that the rightful and true measure of any object is its maker.

Project Notes:

The moral of the story is not to spend too much time worrying about not being able to make a great sounding guitar, if the wood being used is not master quality. There are so many more things to get right

before worrying about the wood, that it makes no sense to waste too much energy on it.

Unless a piece of wood looks really nice and that is the reason for buying it, skip the higher priced stuff. Not only is this easier on the wallet, but in the end it will not make any better of a guitar than you are capable of making. Do not rush out and buy an old pallet or anything, just buy reasonably priced wood and work with it to the absolute best of your abilities. The work will shine through in the finished instrument, and in the end the sound will be the mark of its quality.

FINISHING FOR SOUND QUALITY

The purpose of a finish on an instrument is to protect the wood from dirt, grime and physical damage, and to stabilize the wood during its seasonal expansion and contraction. A finish also adds beauty to the wood by bringing out the natural patterns and colors better. Wood is a hydroscopic material, meaning it takes on water and releases water as needed, to remain in balance with the humidity in the surrounding air. These changes can wreak havoc on the instrument because the swelling especially can cause joints to fail, wood to crack, and parts to break long before they should. A finish restricts the changes in moisture levels over the seasons, and reduces them to a level that does not destroy the instrument.

Finishing has the reputation of being part science and part magic. There are volumes and volumes of information about old Italian violin makers and their super secret finishes that many modern makers are trying to reproduce. The idea being that there is some enchantment or some magic that can be imparted into a piece of wood through the finish. The sad fact is the finish on an instrument (at least in the case of an acoustic guitar) is a hindrance rather than a help when it comes to sound quality. An unfinished acoustic guitar will sound better than a finished guitar, given that all other factors are the same.

The goal of a guitar finish should be that it protects the wood from dings, damage, and soil that comes from playing, while also coating the wood so the expansion and contraction are slowed. After those two goals are met, the last goal is to make the finish as thin as possible so that it does not hinder the guitar from vibrating. The thinner the finish, the less restrictive it will be on the plates, and the more sound will be produced by the instrument.

The deep lacquer finishes seen on production guitars, especially cheap production guitars, are on there so that the guitar is harder for the customer to damage. The factories know that cheap guitars are played rougher than nice ones, and they coat them accordingly. The super thick coatings also make the guitars looks shiny, which makes them look to be better quality than they are. Look at a very expensive guitar and the finish is

much thinner and closer to the wood. These high end makers know that a thin finish means better acoustics, and they also know their customers are buying sound, not looks.

The good news is that there are several finishes on the market that give a close to the wood look, as well as protect the instrument from harm. They will not protect like a thick layer of lacquer will, but a fine handmade guitar should not be handled like a cheap plywood guitar. Plus, most of these finishes can be repaired very easily should there be a need.

The above guitar has a single coat of tru-oil applied to the right side to demonstrate how much a coat of finish changes an instrument. A secondary characteristic of finishing is that is brings out the natural coloring and beauty of a piece of wood. The change that can be seen after weeks of building when the first coat of finish is applied, is almost a religious experience. There are colors and textures now present in the wood that were not there for the several weeks leading up to this moment.

There is not much protection here after one coat, however after several coats there will be. The point of the exercise being to finish a guitar with the least amount of finish required to protect the instrument and, enhance its appearance.

Hand applied finishes are usually the best for this purpose, because they take longer to apply and do not have the ease of spraying which can lead to over coating. Hand applied polymerized oils, wiping varnishes, shellacs and oil/varnish blends will give a thin finish that protects

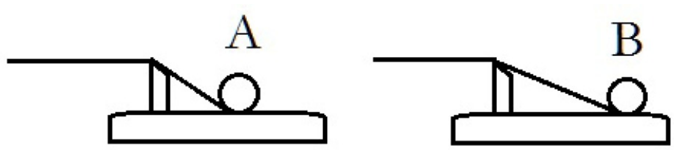
the wood and is very easy to apply. The goal again is to be as thin as possible so the plates can vibrate freely.

Project Notes:

Some finishes protect better than others, and some finishes look better than others. The beauty of most of the finishes that are detailed in the finishing chapter, is that they can be layered for a combined effect. Wiping varnishes offer more protection than oils do, but oils seem to pop the grain better than varnishes. Combining the two, we can use an oil first to really make the grain come alive, then seal it with a varnish to leave a durable top coating. The coloring comes from the oil, and the protection from the varnish.

BRIDGES AND SADDLES

The purpose of the saddle is to place a limit on the section of the string that can vibrate. The angle at which the string passes over the saddle will determine how effective that limit is. Also, the shape of the saddle needs to be correct in order to isolate vibration, and keep the strings from buzzing at either location.

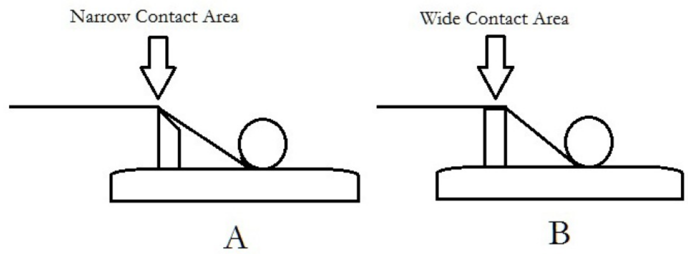


The two bridges in the diagram above show two different placements of the bridge pins in relation to the saddle. Bridge A shows the bridge pins close to the saddle so that the break angle of the strings is very sharp. This will help to isolate the vibration to the playing side of the bridge only, and will also serve to put more torque on the sound board. Bridge B has the pins further away, which decreases the angle at which the strings pass over the saddle, making the break less pronounced. This not only reduces the effect of limiting the vibration area but also reduces the torque on the soundboard.

Keep the bridge pins close to the saddle while designing the bridge and carving it out. There will be a larger gap on the higher strings no matter what, because of the angle on the saddle, but starting closer at the lower end means ending closer at the higher end.

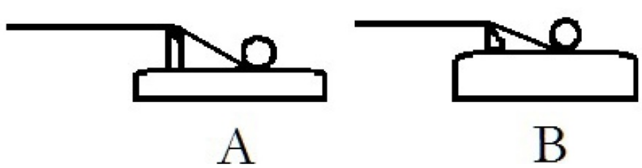
Torque is important because the soundboard needs to be under enough tension to fully drive it while playing. In fact, a bridge that is under so much torque that it slightly dips forward over time, means that the soundboard is under as much stress as it can take. This stress is accentuated when the strings are played, and the soundboard moves more in response. The looser and thinner strings sometimes fail to put enough tension on the top to fully drive it, and the sound quality is lessened because of it. It is wise to use heavier strings that can be tuned to pitch without having trouble

adjusting the neck action. The heavier tuning pressure will add volume and sensitivity to the guitar sound, and make for a better playing guitar overall.



The second area of consideration for the saddle is to carve the top of the saddle so it makes less contact with the strings as they pass over it. Saddle A is carved on an angle on the bridge pin side, and that angle limits how much string contact there is. The top is not as sharp as the diagram looks, as there needs to be a slight radius to allow the string to pass over it as it is tuned. Small nicks in the saddle keep the strings in place as well.

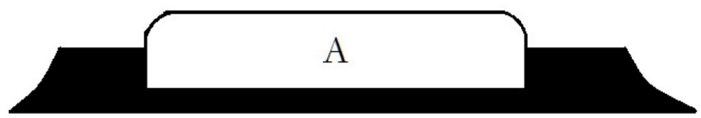
Bridge B has an un-carved saddle where the entire top of it touches the string. This means that around 1/8" of the saddle can possibly be in contact with the string. The result is uneven tuning and problems getting the guitar to tune at all. The large area touching the string means that there may well be buzzes and funny sounds that come from that area, because part of the string is touching one end of the saddle, and rattling against the other.

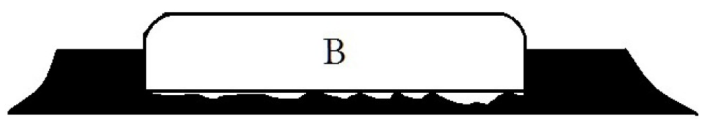


Another thing to take a look at is the height of the wooden part of the bridge in relation to the saddle itself. A natural balance needs to be found between the heights of both so that there are not problems with either. Bridge A shows a short bridge with a taller saddle. This bridge style helps with the string break angle, however if the saddle is too tall it can bend or break while the guitar is being tuned. Bridge B is very thick, which causes

the saddle to have to be trimmed down so much that it barely sticks up over the surface at all. This will reduce the string break angle as well as the torque on the top.

A harmony needs to be found in bridge making that incorporates the positive characteristics of bridge A, without any of the negatives. The saddle should not stick out more than the depth that it is mortised into the bridge. Also, the bridge itself should not be so massive that it overwhelms the saddle, causing the height to become an issue. The bulk of a thick bridge can cause problems if it is so large that it weighs down the top, again reducing vibration. Having a medium thickness bridge and a saddle that sticks out enough to break the strings well, makes for a better functioning instrument.



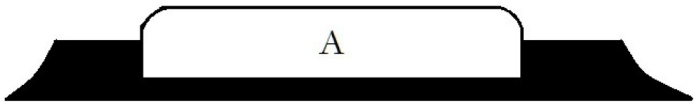


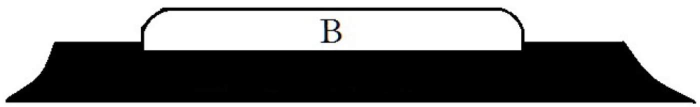
The slot that the saddle resides in also needs to be treated with care, since the saddle is where so much of the vibration and energy is transmitted into the top. When routing the cavity, whether by hand or by machine, great care must be taken to ensure that the bottom of the slot is flat and even. Saddle A is the perfect example of a well slotted bridge, with a bottom that is flush to the saddle. All of the power from the strings is directed into the bridge, and there are no gaps at all. The best way to do this kind of precise work is with a router or Dremel, however with time and patience a saddle slot can be created by hand.

Saddle B is an exaggerated version of what the underside can look like if the slot is not properly carved out. There are gaps, high and low spots, and the saddle may only be resting on less than half of the wood under it. This can cause a loss of power through the strings, and detract

from the playability of the guitar. Taking the time to get the saddle slot correct will mean a better sounding guitar.

A jig for routing the saddle slot is explained in chapter two, and it is very easy to build from scraps. The slots it creates will be level on the bottom and help the guitar sound better.





The depth to which the saddle is routed into the bridge is important as well. A good depth for a saddle slot should be about 1/8" or slightly less from the bottom of the bridge. The depth of the slot will differ from bridge to bridge depending on the thickness of the wood, however the saddle must go to within 1/8" of the full depth. The reason for this is to trap the saddle in place as well as hold it steadily against the vibrations of the strings.

A fully trenched saddle like bridge A will be securely held in place, not rattle or be loose, and have a firm footing where it can transfer the vibration into the top. Saddle B is far too shallow, and may even topple over and fall out when the strings are brought up to pitch for the first time. There is far too much bulk between the saddle and the top that will dampen vibrations, and reduce the volume level the guitar is capable of.

Project Notes:

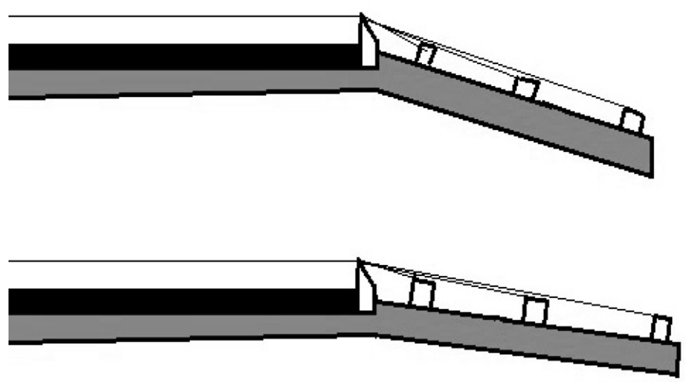
The bridge and saddle are very important to the sound production of the guitar. A poorly constructed or badly designed bridge can make an otherwise great guitar not live up to its full potential. Since this is the connection for the strings, it makes sense to spend the time getting the bridge correct.

Follow the steps outlined in chapter five where it explains how to make a bridge in the most logical manner I have found. It will detail the order of steps to take, to ensure a good looking as well as very functional bridge.

Taking everything into consideration, there are many factors to get right while working on the bridge, however it is not as bad as it looks. Take the time and watch the key elements, and the bridges created will work just fine. Do not stress over any single detail, just do the best to get everything as close as possible.

STRINGS AND NUTS

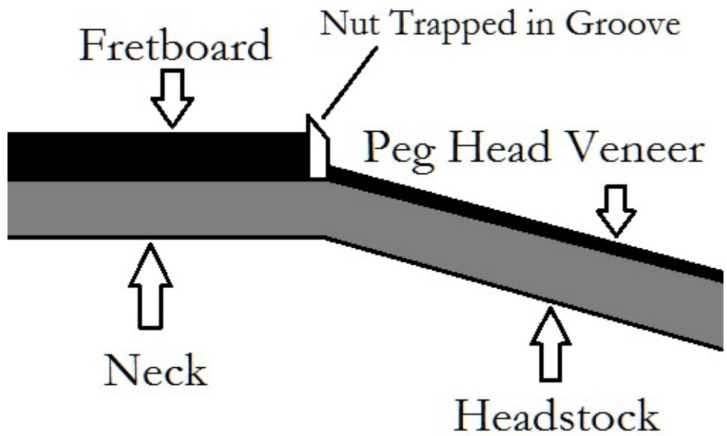
As the bridge must be constructed properly to have a well functioning guitar, the nut must also be looked at because it is half of the parties responsible for holding the strings in place. The nut has to be fitted properly, shaped well, and the string break needs to be correct too. All of these things help keep the strings securely in their slots, and reduce vibration above the nut in the peg head area.



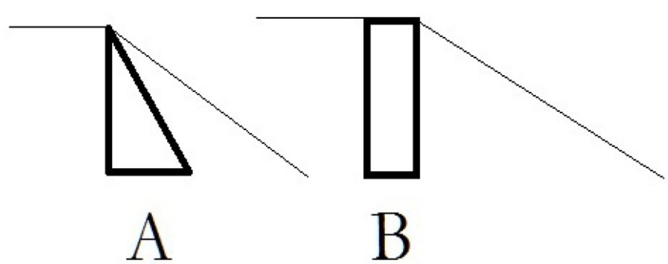
The angle in which the strings break over the nut will determine how well the strings vibration is isolated. A good break angle like in the top guitar neck shows how the strings contact the nut, then travel downwards towards the tuning machines. An angle of around 15 degrees is common, and slightly steeper angles have been made before with success. There are arguments out there for not having a headstock angle over 15 degrees because strings get stuck in the nut while tuning, however if a lute can be tuned with an almost 90 degree peg head angle, the acoustic guitar will be fine. The maximum angle for a headstock is typically no more than 17 degrees anyway, so there really is not much of an issue there.

The bottom neck in the diagram shows an overly flat headstock angle, where the strings are resting on the nut rather than being forced against it. The tension on the nut is going to be lower when compared to the upper neck, and there will be more vibration going on above the nut. Electric guitars are famous for having no headstock angle, however they

use string retainers to pull the strings down right before the nut. In effect this creates a harder break angle and resolves the problem. A neck with the proper peg head angle will keep the strings in place and force the string to vibrate only between the saddle and the nut.



To help isolate the nut and keep it in place, the veneer of the peg head can be planed or sanded to an angle that meets the back side of the nut with a flush joint. The fretboard will trap it on one side, and the veneer on the other. The neck itself forms the bottom of the slot, and it needs to be a snug fit. A drop of super glue will keep the nut in place more permanently, but the help from the surrounding wood is well worth the few minutes of effort.



The last thing to look at is the bevel that is carved into the nut, and how it is an important part of the system. Just like the saddle, having too much nut material in contact with the string as it passes over is not a good thing. There needs to be a small radius on the top of the nut where the

string passes so a sharp edge does not break a string, and the rest can be sanded off.

Having too much material will cause buzzing of the strings, and may also lead to strings sticking in the slots as they are being tuned. Nut A shows most of the material on the headstock side removed, and nut B is not carved at all. On thin electric guitar nuts this is fine, however on an acoustic guitar with a 1/4" nut, carving an angle is necessary.

ALTERNATIVE TONE WOOD

The wood choices for acoustic guitars have evolved into standards that almost everyone in the industry uses. The choices for back and side wood have been reduced to Mahogany, or Indian Rosewood, which really does not do much for the look of the guitar. Mahogany that is not figured can look pretty bland, and though Rosewood can look really nice, there have to be more options than that.

The great thing about building a guitar is that the choices for tone wood are not limited to what the commercial builders decide. There are several options for back and side wood that are not traditional, yet still share the majority of the properties of the industry standard wood.

There are several online websites that list the properties of all the species of wood. These can be compared to the classics like Rosewood and Mahogany to see if they share similar characteristics. If they do, it is a fairly safe bet that they will also make good guitars. These sites list attributes like weight, density, flexibility, ease in finishing, and other useful traits of a species of wood. In general, looking for dense wood that is fairly easy to work and finishes well, is a good choice for a guitar back and sides.

The following are a selection of alternative wood species that I have made guitars from, and how they performed. These alternative species are not very expensive, since the demand is low, and they all make excellent guitars.

Bubinga is a an African wood, that is commonly available in most hardwood stores, and at a lower price than most of the rest of the wood. Highly figured pieces can cost more, however most Bubinga wood will have a nice looking grain pattern even in the average stuff. The colors range from a medium pink to a deep brown, and there are small black lines that run throughout the board, giving it character. It is a hard wood that works easily and bends easily too if the sides are soaked first.

Padauk is another African species that has a bright orange to red color when freshly cut, and oxidizes over time to a deep brick red with black accents. This wood works easily, bends well, and comes in many striking grain patterns. It is on the same expense level as Bubinga, the only

issue being the sawdust is a natural dye, so sanding can be hard. If the red dust gets on Maple bindings, it can be tough to remove. Use a cabinet scraper instead of sandpaper to help with this.

Sapele has similar tone traits as Mahogany, and is a member of the mahogany family. It works well, finishes well, and bends easily. The difference between Sapele and Mahogany is in the amazing ribbon stripe figure that comes out during finishing. The ribbon figure is what makes Sapele desired by woodworkers, and the fact that it works really well. A piece of Sapele can be used for any part of the guitar, the top, back, sides, neck, bridge, binding, literally anything. It is inexpensive too.

DOCUMENTATION

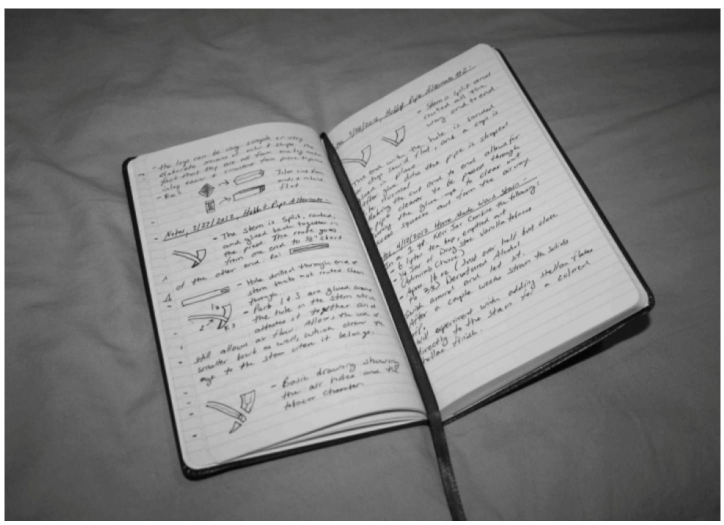
Keeping good records of what is being built, as well as how it is being built, is a very good habit to get into. Since we are not making dozens of sound boards a day, or several of the same pieces, it is useful to have a reference to go back to. This is done in many ways, but usually consists of a notebook for the technical data, and through taking many pictures.

A good notebook is very important to have while making guitars, and keeping it up to date is even more important. There are several kinds of notebooks out there from the very expensive leather bound masterpieces, to cheap flimsy spiral bound junk. Since documentation and recording are so important and so much can be learned from it, take the few extra dollars and invest in a nice notebook. It has been my experience that a cheap notebook will be treated like it is worthless, when in reality the years and years of contents inside are almost priceless. A more expensive and nicer notebook will be treated better, taken care of better, and most importantly used more.

The notebook should have lines inside it where the spaces for writing are clearly defined. There may be the need for tables and charts at some point, so having the lines helps organize things like that. Several

places sell this style of notebook with a leather cover, about 1/2" thick, and they cost about the same as a sit down dinner.

Items to document in the notebook include construction details like weights, sizes, and dimensions of different parts of the guitar. The soundboard is the most documented piece, and it is not uncommon to have details on how thin the soundboard was planed, the weight of the board without braces, the quality of the cut, and the number of grain lines per inch. After the board is braced and carved, it is also useful to keep a record of the final weight, size, species of the bracing, and dimensions of the bracing. All of this data may seem like a pain to collect, but all of these figures are used in the normal course of guitar making. The thickness of the top plate is found while carving, it, the braces are sawn with a fence or a stop of a certain width, and so on and so forth. None of these numbers will require any more effort than simply writing them down.



The open book may look something like the picture above, where there are instructions for how to make a custom inlay and part of the process in making a tobacco pipe. These books offer far more than just recording data and measurements, they are a place to record ideas that are discovered while working in the shop. Ideas come and go way too fast to remember them all, and most of the time a good idea will be lost if not recorded somewhere. The notebook will provide a place to keep everything that can be referred back to whenever it is needed.

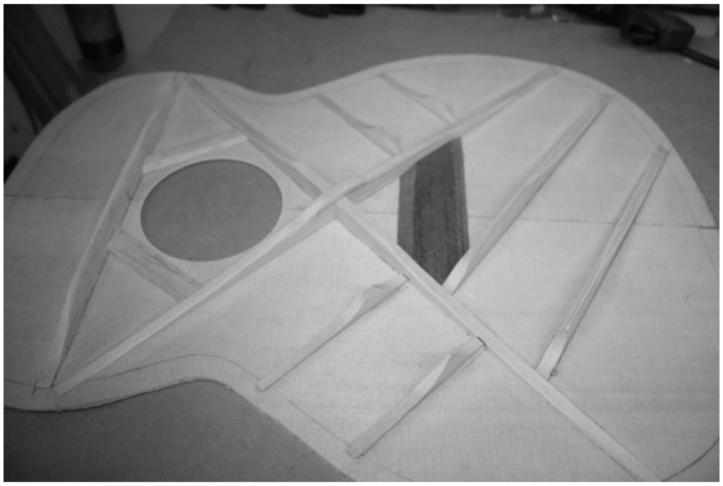
Date each entry and add an appropriate title so the book can be scanned through to find a certain section without difficulty. Also, it is better to have more detail than less, so do not be afraid to add things that may seem unimportant at the moment. These small details may end up being very useful later on with the next project. Should a guitar ever be made that sounds much more amazing than normal, the ability to duplicate it will all reside in that notebook.

The next part of documentation is taking lots of pictures while working in the shop. In the age of digital cameras, there is no reason not to take an excessive number of pictures. There is no cost difference between taking one picture and taking ten thousand, so long as they are stored on the computer and viewed there. A digital camera that is good enough for the purpose but not so expensive as to worry about getting dirty, can be found inexpensively, and is worth every penny. The ability to review pictures after a build will help in several ways.

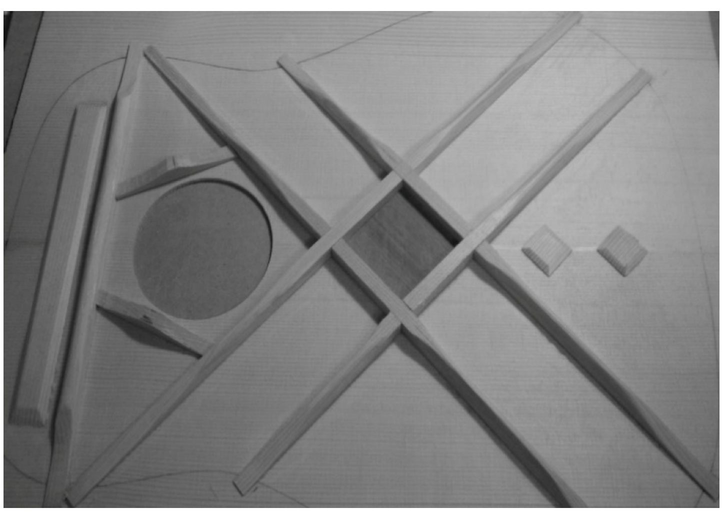
First, old pictures from long ago builds can be reviewed to see how the guitar was made. The pictures of the bracing patterns, internal blocks, and general construction will be important information to have. It is hard enough to remember yesterday let alone several years ago, but pictures make it easier.

Pictures also show how the work has progressed over time, and how building methods have changed over the years. Over time skills change, and methods for doing things change. Most of the time this is for

good, however sometimes it is nice to look back and find some methods that may have been forgotten, and revive them.



The main focus of picture taking for me has always been the sound board bracing. This is an area where much of the sound of the guitar is controlled, so knowing what each one looked like on the inside helps with making future tops. Try and get as many pictures of the guitar top after the braces are fully carved as possible. Get them from a few different angles too, because all that will be left are the pictures once the guitar is gone. Since we cannot go back in time, do not end up wishing more pictures were taken, take them while the opportunity is there.



Pictures can also teach lessons about guitar making, and what works and does not. The above picture was of an experimental top I did, with a double x-brace pattern that I thought would revolutionize guitar making and make me rich beyond my wildest dreams. Though that did not happen, it did teach me about how the top works. I now know that there was just too much wood to allow the guitar top to vibrate enough to make a good sound. Seeing the braces again after playing the guitar helped me to figure out that the bracing was just too much.

Keeping a notebook full of ideas and measurements, as well as taking pictures can really make a difference for guitar building. Try taking notes on as much technical data as possible, and keep the notebook in the shop while building. Take pictures as well, and load them on the computer with a date on the folder. Documentation can teach a lot, and can really come in handy.

Project Notes:

Another good reason to take pictures along the way is for sending to the customer. I always send pictures every few days of the progress being made on their instrument. It gives them a look into the shop, knowledge about how far along their guitar is, and something to show their friends. My customers have told me they love getting these emails, and they look in their inbox constantly hoping to see another email from me. It is a really solid hook that keeps the customer interested throughout the waiting process, and builds up excitement over seeing the final product.

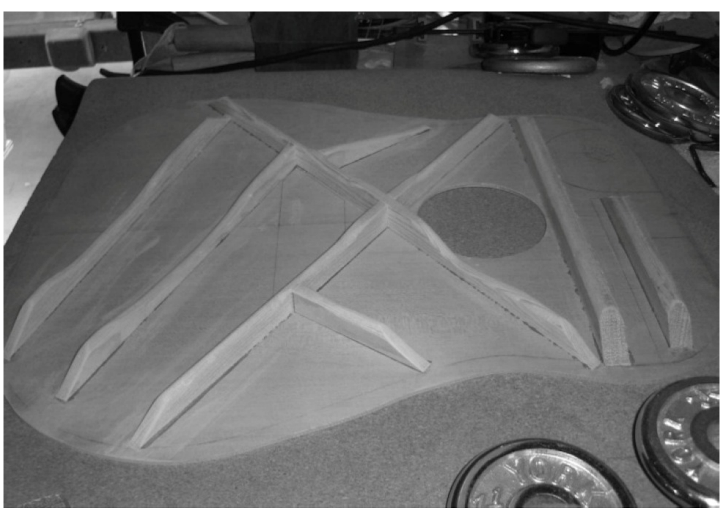
After the customer receives their guitar, give them a computer CD that contains all the images in chronological order. That way they have their own slideshow of how it was made, as well as a solid sales presentation every time they show it to one of their friends.

MOSTLY RIGHT

Guitar making can really seem overwhelming at times. There are so many sources that say so many things, and after a while it can drive a person insane. There are basic rules to follow, things to listen for, fractions of inches to monitor, and that is not even beginning to get into the really deep stuff. Some people see guitar making as this exercise that only a few people can understand, and that the planets need to be aligned just so to make a good guitar. Let me say right now, that is a bunch of crap.

The point of everything in this chapter is to show how some aspects of guitar making can be controlled to make the instrument sound better. It is not intended to be taken too literally to where twenty bridges are thrown in the trash because they are not perfect. The important thing about making an instrument is to get everything mostly right.

There are a few things that really need attention like scale length, fret placement, and structural considerations. A guitar will not play well if the scale length and frets are wrong, and it will not play at all if the structure breaks down and the guitar collapses. Other than that, there is really not too much else that needs to be done exactly perfect for the guitar to be fine in the end.

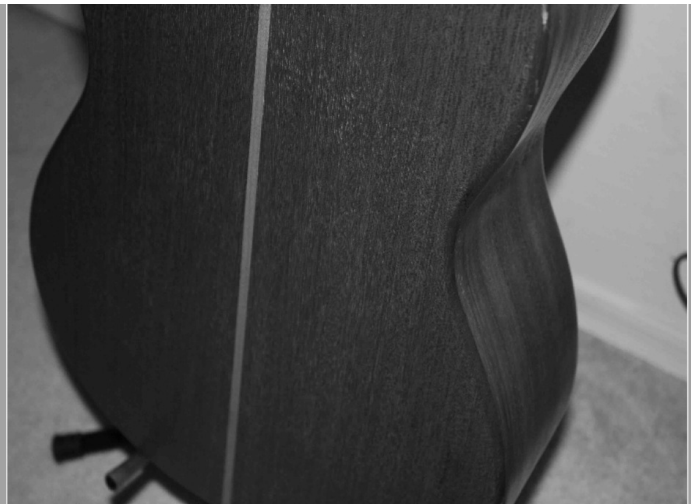


The above picture shows the bracing from one of my very first instruments. The tone bars are massive, the carving terrible, and all the pieces just too thick and clunky. These would be considered to be about 80% completed, because a little more carving and some sanding would make them far more presentable than they are. However, the rest of the guitar went fairly well. The body glued up well with no leaks, the neck attached well and lined up to the bridge just right, and the action came out in the medium range. Even though the one aspect of the guitar was a minor disaster, the instrument came out fine. The point is not to worry if a clamp slides and a brace ends up 1/4" off position. These small things will happen along the way in the beginning and there is nothing to do but learn from them.

If a guitar has a good neck to body attachment, a solid body with no air leaks around the rim, and the action is close enough that it can be strung and played, the guitar will sound fine. Take the time to try and do everything perfectly, however if something comes up a little short, it is not a big deal.

Guitar making is not the mystery that some make it out to be. It is a skill like any other, and it can be mastered over time through practice. The problem with any skill is that it never gets easier on its own, we only get better at it through practice. Spend some time making guitars and the things that were once a challenge will become just part of the build. New things will present themselves, but as long as the fundamentals are right, the rest is just details.

Project Notes:



In another early guitar, the original set of sides were broken on the bender in an attempt to get a piece of wood to bend before it wanted to. The new sides I found were not exactly the same color, and in fact they were not even the same species. The back was a Mahogany from one place in the world and the sides were from another. They were way too light in color, but knowing it was a cosmetic issue, I pressed on with the build. I was not able to get it to even out in the finish, and in fact, it made it worse. The difference and the poor match could be seen from space, and there was nothing that I could do about it. All that being said, the guitar played fine, and I still have it. The moral of the story being not to let a mistake stop the process, and to always keep your first instrument.

Chapter Five

GUITAR MAKING METHODS

There are as many ways to make a guitar as there are guitars themselves, and really all of them are right as long as they make a good guitar. There will always be some methods that are better than others, but all good techniques will produce good results.

The following projects outline what I believe are the best ways to accomplish certain tasks in guitar making. These have come from years of making guitars, and from having tried several ways of doing everything.

There are often times very simple ways of doing things that seem complex, and it is often the simple ways that are overlooked. Small details like binding on a fretboard, or a nice exotic wood pick guard are all easy tasks, but they set the guitar apart from others. Knowing easy ways to add visual appeal and value to a guitar is very important for the creative luthier.

The projects contained in this chapter will give a step by step description of how to accomplish the task, as well as pointers along the way. For example, the bridge making section revolves around doing the most difficult operations at the beginning, so that the chances of ruining a bridge blank late in the game are minimized. This is the best way to create the bridge, because the hard stuff is all done and over with right in the beginning, making the rest of the project less stressful.

In the section on making custom pick guards, the emphasis is placed on using simple materials to create an amazing looking and artistic addition to the guitar. Exotic veneer is inexpensive compared to a store bought pick guard of the same material, and it can really add flash to the guitar. Any three sheets of veneer can be made into a really nice looking pick guard with a minimum of work, and again it is the simple things that make the big differences.

Guitar making methods are the same exact steps and procedures that I do in my shop, without any deviation. So often, a guitar making book says to do something a certain way, when it is obvious that they never do it that way. Making the bridge is a big example. Nobody spends an hour cutting out the saddle slot with a 1/8" chisel, but that is how it is explained in some books. Everyone uses a power tool to route the saddle slot, and that is how it is explained here.

The reason many books use alternative methods is because not everyone has all the same tools as a professional guitar maker. Understanding this, there are always several methods offered for most tool related tasks. Just because someone uses a jointer for something, does not mean there is no other way of doing it. A router and a flush cutting bit make an excellent edge jointer, and so does a flat surface and a large piece of sandpaper.

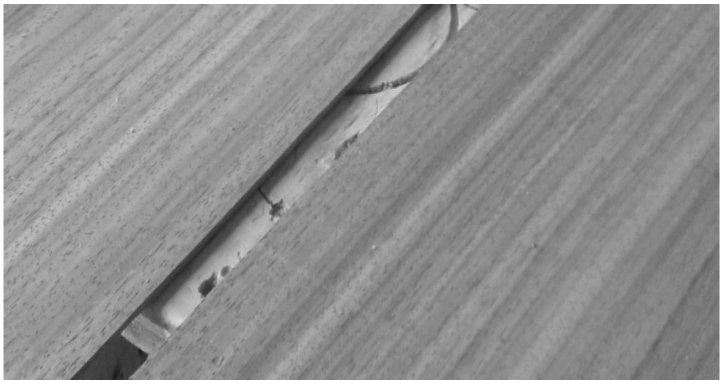
The focus of the methods section is to get people thinking about how to use the tools they have to do what they need to do, as well as how to accomplish the everyday tasks in guitar making. So often the error is made in thinking that a new tool will solve all the problems that are currently being faced in the shop. While tools do help, spending some time looking at the task at hand, and trying to figure out alternative methods will be far more helpful. It is better to have a really good way of doing something than to have a shiny new tool that is unfamiliar to operate.

The following methods will outline several ways of accomplishing a guitar making task by using methods or tools that are not what is normally called for. They were born out of necessity, and prove that a few tools can be used to do the work of a whole shop, if set up the right way.

In This Section We Will Cover:

here.

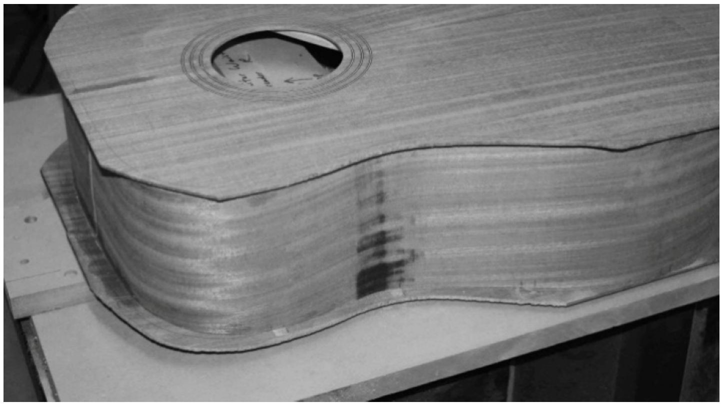
The best order of operations for making a bridge to minimize ruined blanks. See here.



A creative way to book match the plates and get the joining edge very clean. See here.

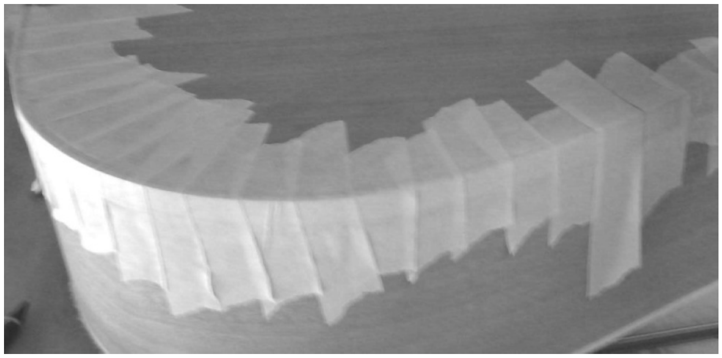
How to glue arched braces to the plates without a go deck. See here.

Making and inlaying an easy three ring rosette with a Dremel tool and circle cutter. See here.

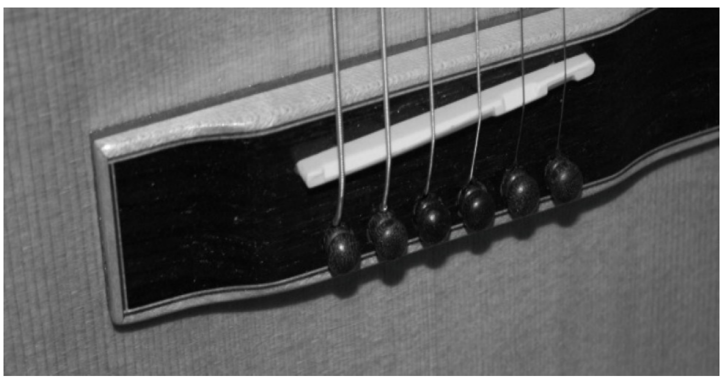


How to use a router to trim the plate overhang after gluing the body. See here.

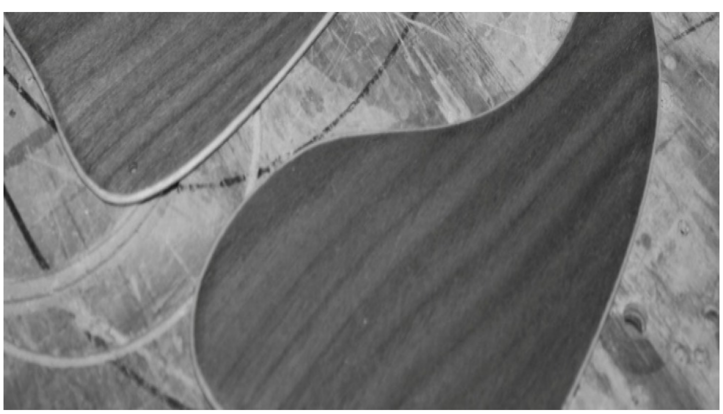
How to use a rabbet bit set for the router to make binding and purfling ledges. See here.



Installing binding and purfling on the edges of the guitar. See here.

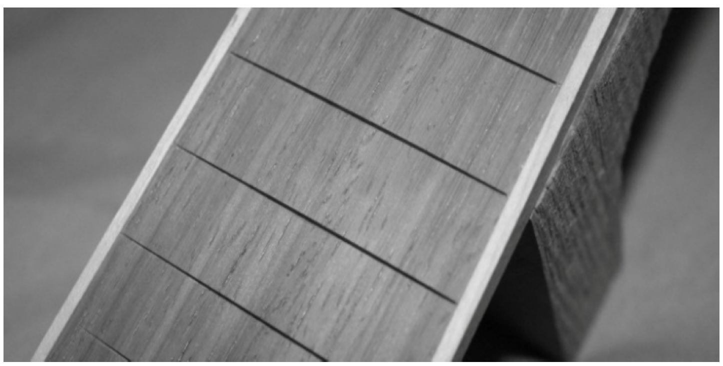


Using binding strips and laminated wood on the bridge for an eye catching look. See here.



Making custom pick guards from exotic veneer pieces, and finishing them. See here.

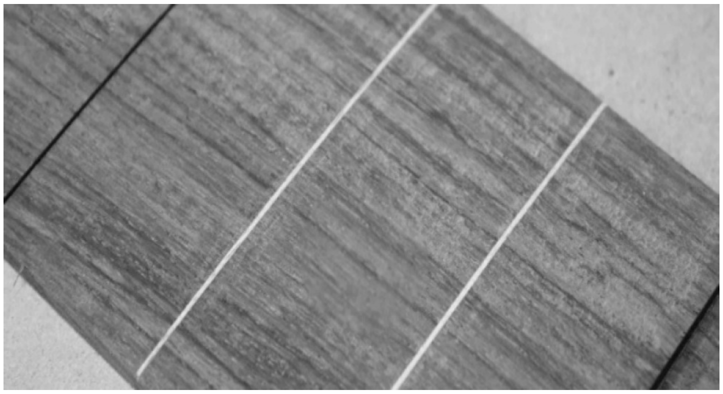
Using a router and a flat edge to taper the fretboard before fretting. See here.



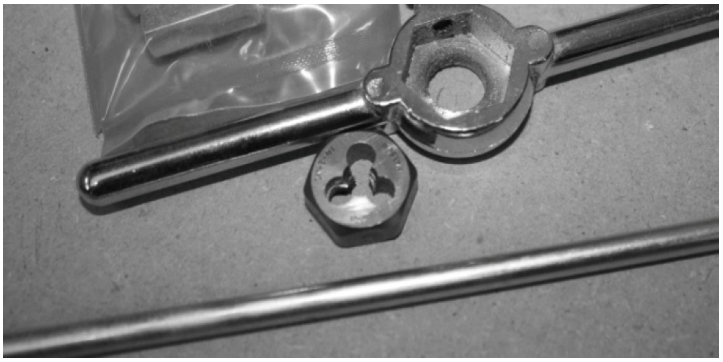
Binding the fretboard, and how to take advantage of a classic look. See here.

Fretting the board while it is off the neck, taking advantage of more versatility. See here.

Using alternating species of wood to create an attractive heel cap. See here.

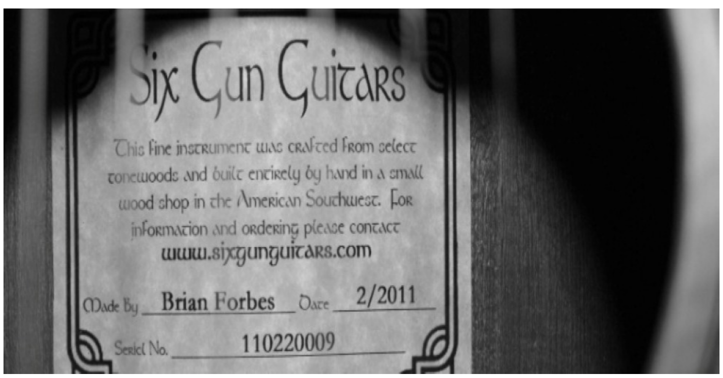


An easy fretless conversion for the bass guitar neck, using veneer strips. See here.

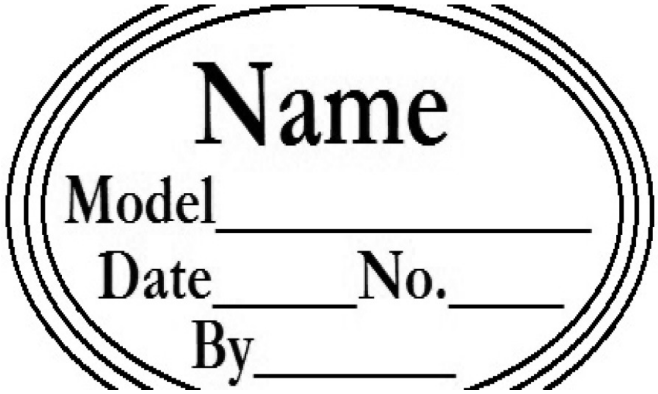


Making truss rods from materials found in any hardware store. See here.

How to glue on peg head veneer to accent the headstock and hide any joints. See here.



Making custom guitar soundhole labels using advanced photo editing. See here.

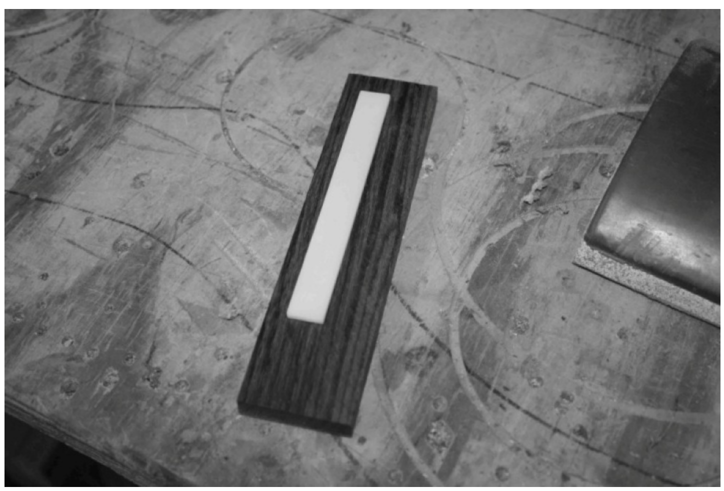


Creating custom labels for the guitar using simpler methods and common programs. See here.

MAKING A BRIDGE

The bridge requires several different steps to construct, and a few different woodworking techniques. Some of these steps are easier than others, which is why this particular order of operations was developed.

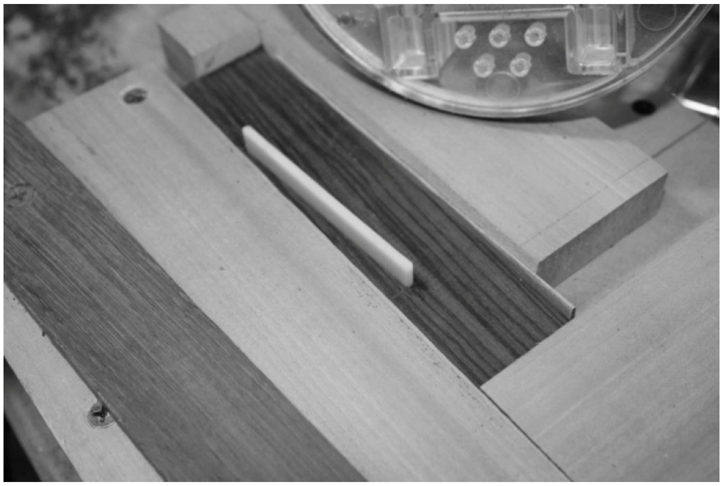
The most difficult and important steps are completed first, so that they are out of the way before the easier operations are done to complete the piece. This way, if a mistake is made during one of the more difficult phases, it is not a big deal to toss the blank in the scrap bin, and start on another one. When the hard parts are saved for last, a beautifully sculpted, and labored over bridge may have to be dumped because the saddle slot came out terrible. All the work that was done in the beginning is now worth nothing, because the piece cannot be used.



The only materials needed for this method will be the bridge blank and the saddle blank. The bridge blank should already be dimensioned to the proper length, width and height. The saddle can be made from any material used for the purpose, the one in the picture is bone.

The first step in the construction process is to route the saddle slot in a jig. The jig in the picture is explained in chapter two, and it will allow an angled saddle slot to be routed in the bridge. A piece of wood and a screw holds the bridge tightly in place while it is cut, and the slot end up very straight and of an even depth.

This is often times the hardest part to get right, because the bit has a tendency to drag into the surrounding wood and make a slot that is larger than it should be. Sometimes the router is not set in place carefully enough and the top of the bridge is dinged where it cannot be scraped or sanded off. This makes the bridge useless, so we get that operation out of the way first, before moving onto the next one.



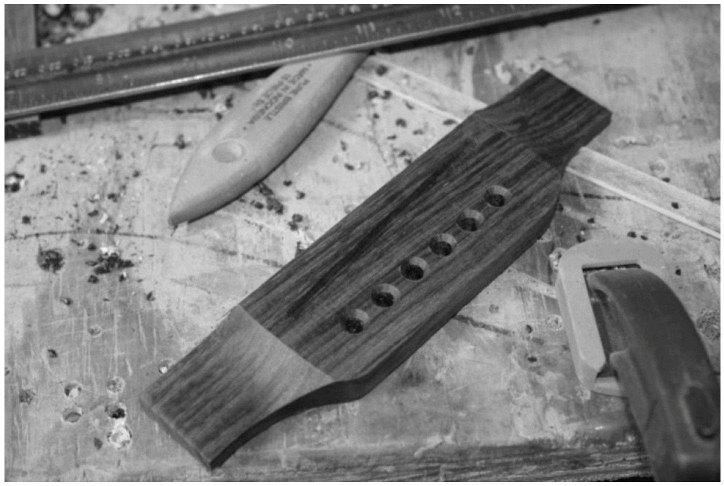
The above picture shows the bridge blank having been slotted and the saddle being test fitted into the opening. The jig will allow for widening the slot for a thicker saddle like the bone piece in this example. Also, this slot will end up being made a little deeper than pictured.

Drilling the holes for the bridge pins is the next step in the process. This is a little more difficult than later steps, but not as much as routing the saddle. Using the drilling guide explained in chapter two, the holes are drilled. The guide is clamped into position on the bridge, over previously made marks for lining it up. It is clamped into position and drilled carefully using a hand drill or drill press.

The guide is designed so that the holes can be drilled using an electric drill, or in the drill press, but either one seems to work just as well. The important part to remember is to drill as straight as possible, but the guide will help with that. Also, make sure to drill all the way through the piece, which seems obvious, but if the guide is removed and a hole is not all the way through, it will never get back in the exact same position. Look for sawdust from the wood under the bridge as the holes are drilled. This plus the feeling of punching through into the next board will signal that the full depth has been reached.

With the saddle slot created and the holes drilled, the bulk of the precision work has been completed. The rest of the work is either easier or simply cosmetic in nature.

Using a countersink, bevel the bridge pin holes a little bit so the heads of the pins have a place to sink into when installed. Mark out the general shape of the bridge as well.



The holes have been chamfered and the carving process can now begin. The first step is to cut out the profile that was drawn on the bridge with the band saw. Follow the lines as closely as possible without going over them, and remove all the bulk waste wood. The next step is to carve down the wings on each side, trying to keep them as even as possible. Do not let the center part of the slope touch the saddle slot, but come to within about 1/4" of it. This is best done on a belt sander, though it can be done with a chisel and sandpaper stuck to a dowel rod.

The last step involved is finalizing the carving and smoothing everything out. The final elements of the carving are done with a file and a belt sander, and everything is blended into each other using finer and finer

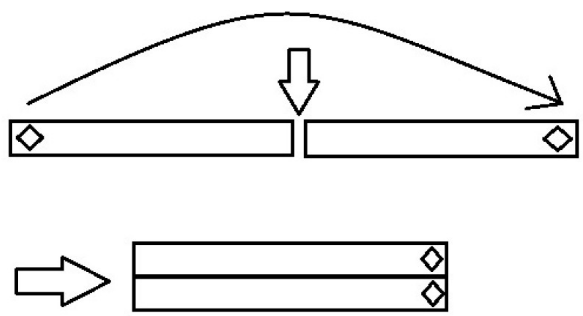
grit papers. Stop the shaping process once everything is smooth, and the whole surface has been gone over with 320 grit sandpaper.

After sanding comes the optional step of buffing. This is not necessary, though it does give the bridge a very smooth final look. Using a finish over the bridge will give a similar look if the piece is not going to be buffed, however buffing will really level it out and make it shine. A buffed and wax bridge requires no further finishing before installing on the guitar.

BOOK MATCHING THE PLATES

The most important part of making a top or a back plate for the guitar is making sure the center joint is perfect. The joint will be visible all the time on the top of the instrument, and any problems will be easy to spot. The back plate is a little more forgiving, especially if a strip will be inlaid over the center seam, but the joint still needs to be good for structure. Having tried several methods of getting the center joint right, this is one that really makes the job easy and accurate.

The most obvious way to get this joint correct is to use a machine jointer, however if a router is available, it can be used the same way.



The first thing that needs to be done is to get the boards positioned correctly for the joint to be cut properly. The above diagram and the pictures will show how this is done.

Lay the pieces out on the bench so they are a mirror match of each other. Now, grab the left board by the bottom left corner (shown as a diamond in the diagram) and fold it over to the right as if closing the cover of a book. The piece on the right should never move, and the center joint will be the hinge so to speak, allowing the left piece to fall on top of the right piece. This is how the pieces need to be arranged in order to trim up the end for gluing.

The arrow pointing right in the diagram shows the part of the boards that will need to be jointed prior to gluing. Once the edges are square and straight, the joint will look perfect when glued.

A flush trimming bit will be needed as well as a good router. This kind of bit is used to follow along a surface with a bearing and cut

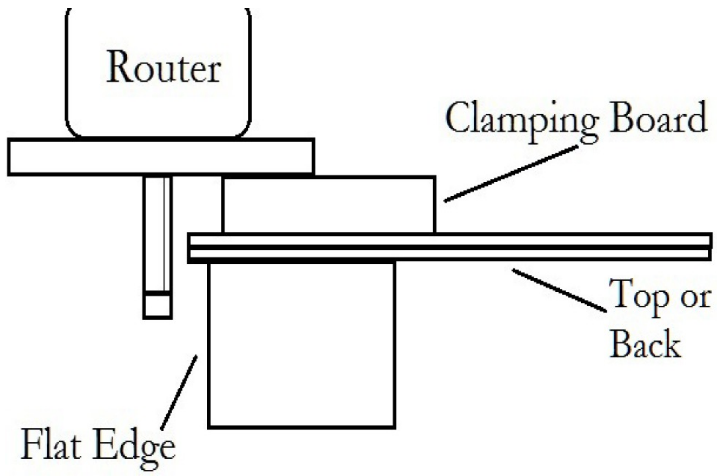
whatever is above that bearing to the same profile. If the bearing is ran along a straight surface, the resulting cut will also be straight. This is where the most important part of this setup comes in.

An object that is known to be straight and true is required to be used as a guide for the router bit, as it cuts the edges of the joint. In my case I have a very old level from my father that has a completely flat and straight edge. This is not the case with all levels today, and cannot be taken as a rule when going to the hardware store. There are many good looking levels out there that are very wavy on the side.

There are several items around the shop that can be used for this purpose until a long term solution is found. One of which is a piece of MDF with a factory edge. MDF has as close to a straight edge as can be found in wood, and will work for a few passes before the bit digs into the edge of the wood, making it not straight anymore. Another solution is to use a piece of laminate counter top turned on edge, or a piece of angle iron from a hardware store. All of these will provide an edge that is nice and straight, and a place where the bearing can ride along.

A side of a table saw, if it is thick enough and not full of holes, can also be used as the straight piece, and will probably be fairly accurate. It only needs to be about 22" long in order to do the job, so the table saw top is normally a good option. In the absence of all of these, the edge of a desk can be used, though it may not be exactly safe for the desk. Looking around the shop and the house, there is usually something that can be found to do the job.

The next step is to find a long board that is longer than the guitar back or top by a few inches on each side. This is used to clamp the guitar wood against the straight edge. The overhang is required so that the router can go back and forth without the clamps getting in the way of the cut. It does not need to be anything fancy, however it does need to be flat, because the router will be riding on top of it.



After the pieces have been gathered, set up everything the way it looks in the pictures and the diagram. In the diagram above, the viewpoint is from the side, showing all the pieces and how they fit together.

The flat edged piece is on the bottom, and the bearing of the router bit will ride against it while making the cut. The boards are next, and they need to overhang the flat item very slightly, so that a little of their edges are trimmed. There is no need for any more than about 1/16" of hang over, because only a little wood needs to be removed to make the joint. Plus, if the joint is not done correctly on the first pass, having some extra wood left behind will be a good thing.

The top board comes next, and should be placed a little ways back from the straight edge and the guitar wood, because we do not want the flush cutting bit to take any of this material away at all. The purpose of this board is for clamping assistance and to give the router something to ride on. As long as it is not ruined by cutting into it with the router, it can be used over and over again.

Once everything is set, clamp the ends of the clamping board down to the bench as far away from the guitar wood as possible. The board

will act as a caul and spread out the force of the clamps, so the entire setup will be locked in place. This can be seen in the first picture on this page, where the bar clamps hold everything together.

It is also recommended to clamp the setup diagonally like in the first picture, because the bar clamps have an easier time going into position, and if they need to be adjusted for a second pass it is fairly easy.

Once it is locked into place, adjust the router bit so the bearing rides along the flat surface, and so the cutter will be in contact with the guitar wood. Bring the router into position on top of clamping board, and test run it while off, making sure the entire length of the joint can be cut without hitting the clamps or needing to move the router away from the flat surface.

If this is all correct, turn on the router and begin the cut slowly. Make contact with the flat edge first, then bring the router into the guitar wood. Keeping the bearing against the flat edge, pull the router along the entire length of the setup. It is very important not to let the router come off the straight edge, and not to stop while making the pass. Stopping can cause dimples that will leave gaps in the glue joint, and coming off the straight edge will leave humps that will not allow the joint to close well.

Once the pass has been made, turn off the router and check the result. Remove the pieces, and open them by reversing the way they were closed. This will put the two edges that were just trimmed together, and make a solid joint. Hold the two pieces together up to a strong light, and try to look for light coming through the joint. If there is light in some places, set up the router again and make another pass, again making sure to use firm and even pressure through the cut. Check the boards again by looking at the light, and the gap should be gone. If it is not, and it is in the same place it was earlier, the straight edge may not be exactly straight. In that event, find something new to use as a flat edge, and try again. If light shows through in a different place, it is just a practicing issue, so make the cut again. When there is no light visible trough the joint, the work is done and the pieces can be glued together. The instructions for a gluing jig can be found in chapter two.

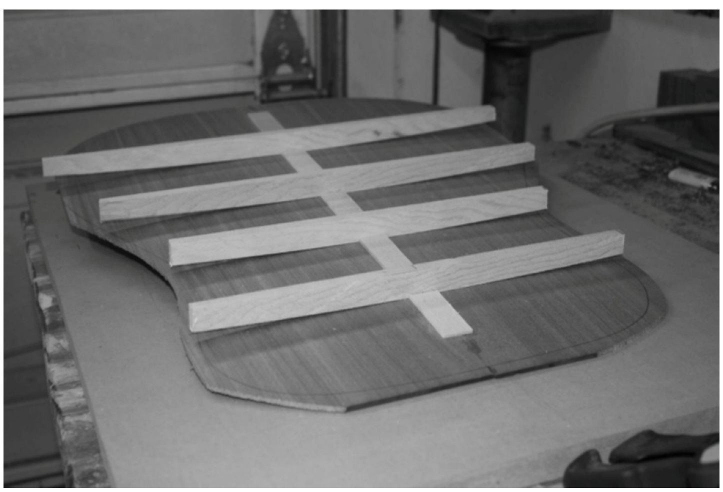
GLUING ARCHED BRACES

Braces that have been arched will need to be glued to the plates a little differently than if a flat set were used. There are a number of clamping methods including the go-deck with dishes, however this may end up being too elaborate for the recreational guitar maker. Thankfully, there are other ways to accomplish the same task.

A simple method of arching the plates involves clamping the braces down with several deep throated clamps, whereby the plate conforms to the arch of the braces, and when dry, takes the same shape permanently. A large number of clamps will be needed to accomplish this, and there are instructions on building clamps in the Tools chapter.

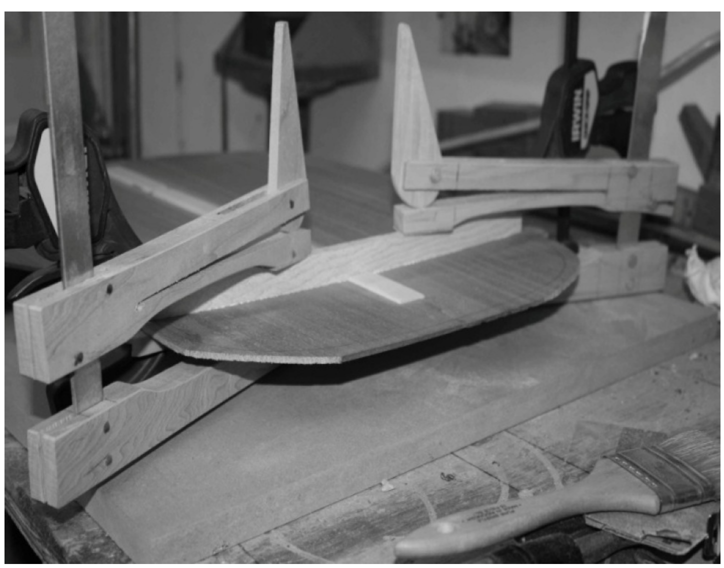
The advantage to doing it this way is there will not be any extra space needed to place and store another large tool, and the clamps will already be in the shop anyway. A go-deck is nice to have, however not everyone has the room for it.

Begin with the back plate as it is seen in the picture above. The two plate halves have been joined, the rough outline sawn, and the center reinforcement strip glued into place. Notches have been chiseled out of the areas where the braces will need to be glued, and the braces themselves are also cut to width, length, and tapered using a template. The instructions for making the arching template are in chapter two, and it is very easy to create.



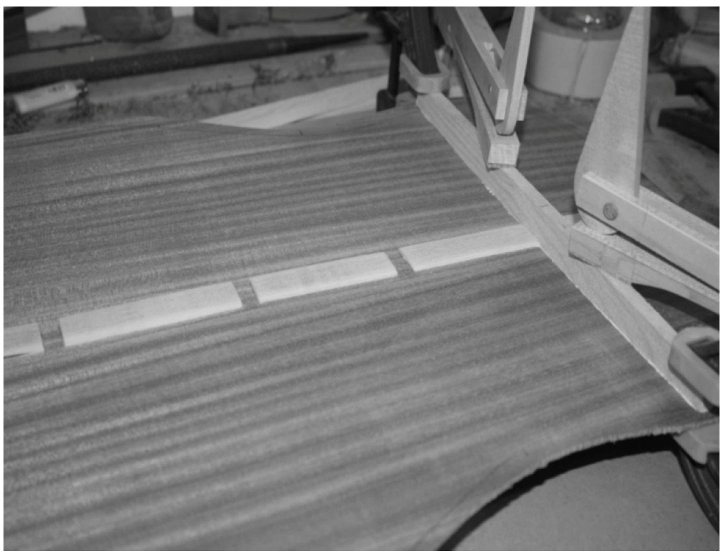
Laying the already arched braces on the flat back plate, it should now be easy to see how this process will work. The plate has flexibility to it, and the braces do not. The force required to bend the plate to the shape if the braces is lower than the force required to do the opposite, so the plate will conform to whatever shape the braces are carved to.

Depending on how much deflection is carved into the braces, the back plate itself may take on a fair curve or an extreme curve. The back plate is far more forgiving when it comes to really making a strong arch, and this can have a very positive effect on the sound as well as the look. Heavily arched back plates trap and direct sound waves back towards the top, where they further excite the soundboard, and increase vibration. This in turn makes more sound, feeding the cycle again. The look of a curved back over a flat back is also a key feature of the guitar, giving it the look of a well made instrument, and preventing a flat back plate from looking concave.



When gluing the braces like this, it is important to work with them one at a time. The large number of clamps that will need to be placed will require more time than when gluing flat braces, and working on any more than one brace runs the risk of the glue tacking too soon, and not adhering the brace very well.

Apply a little more glue than normal to the bottom of the brace, which will compensate for only applying glue to one of the two mating surfaces. Lay it where it belongs on the guitar back, and slide it back and forth a little bit to spread out the glue. This motion will be in the same direction as the length of the brace, and only 1/4" in each direction. This rubbing smears out the glue, making for a better joint.



Place a couple clamps on the center area of the brace, with cam clamps or lapstrake clamps being the best choice. On the edges, smaller clamps can be used to reserve the deeper clamps for the centers of the braces. A simple small bar clamp or a spring type clamp will work perfectly for holding the edges in place.

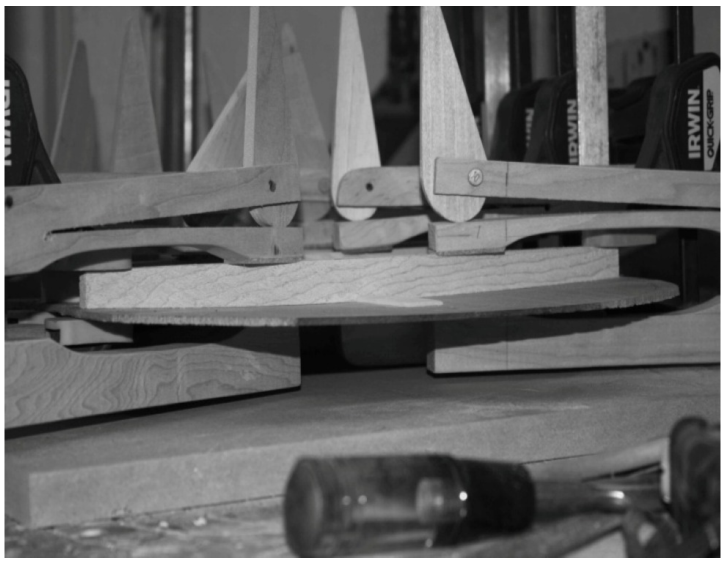
Check that the brace has not moved from where it is meant to be placed with all the extra clamping, and if so add some extra pressure to the clamps to keep the brace where it is.

Repeat this process on the next brace, applying glue, placing it correctly, and clamping it down along the entire length. The clamping is the most important part of this technique. Several clamps are needed to spread out the pressure, and ensure that the brace is well glued to the plate afterwards.

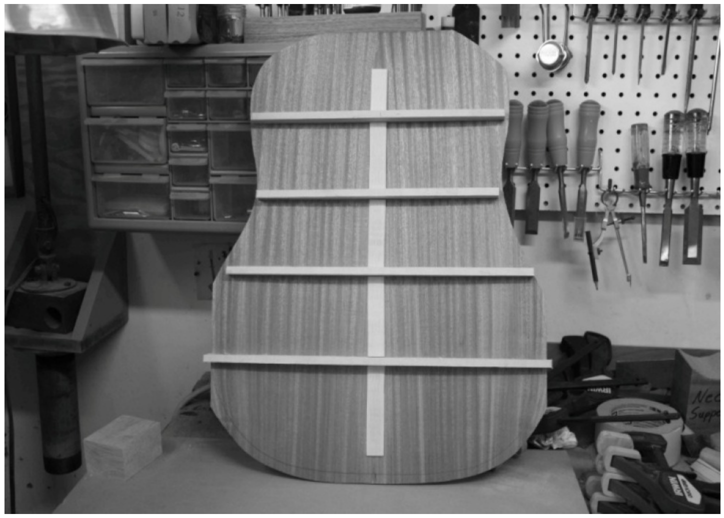
At first this process will leave the back plate dangling in the air and be very lopsided, however as more clamps are added they will begin to act as legs and hold up the piece. Doing one brace on each end will encourage the piece to remain level faster than working from one end to

another, and both ways will work as long as the clamps are kept out of the way of each other.

Leave the plate to dry for several hours or overnight, then remove the clamps and inspect the joints. Any that have not adhered well or have gaps can be removed with a chisel, the surface sanded to remove all the glue, and a new brace glued in. If the clamping was done correctly, there will be no need for that, and all the braces will be well glued to the back plate.



Looking at the edge of the plate from this angle, it is easy to see the arching that the braces force the plate to conform to. Strong and even pressure over the entire length of the brace itself makes this work, and forces the shape. As long as the gluing surfaces meet evenly, and there are not any gaps, the brace to plate joint will be very strong. The curve may not look too intense at this point, but it will definitely be present on the finished guitar.



Once the braces have had several hours to dry, the clamps can be removed and the braces and plate will look like the picture above. All of them should be very straight and even, and the plate itself should have a nice curve to it when viewed from the other side. A quick inspection of the curve is also important, just to make sure it looks even and there have not been any gouges or dings from dirty clamp faces made in the wood.

The braces can now be carved as normal, and the plate will retain the arch throughout the rest of the process. Carving has to be done carefully as not to damage the dome shape, but is easy enough with a very sharp chisel.

One of the larger challenges in this process will be to keep all the clamps out of the way of their neighbors. As can be seen in the picture above, it takes an incredible number of clamps to make this process work. There are nearly twenty clamps on that back plate, each one of them very close to the next.

When applying the clamps to the braces, try and place them so they are as close to parallel to the brace itself as possible. This can only go so far because they are clamping that same brace, but swing them to one side so the clamp body rests against the brace as it is clamping. This will serve to keep the clamp bodies out of the way more than if they were placed perpendicular to the braces.

Project Notes:

Especially on something as important as a soundboard or a back plate, leave the clamps on overnight to ensure the maximum bond between the glue and the wood. Typically wood glue is ready to go in a few hours, but a full strength bond takes longer than that.

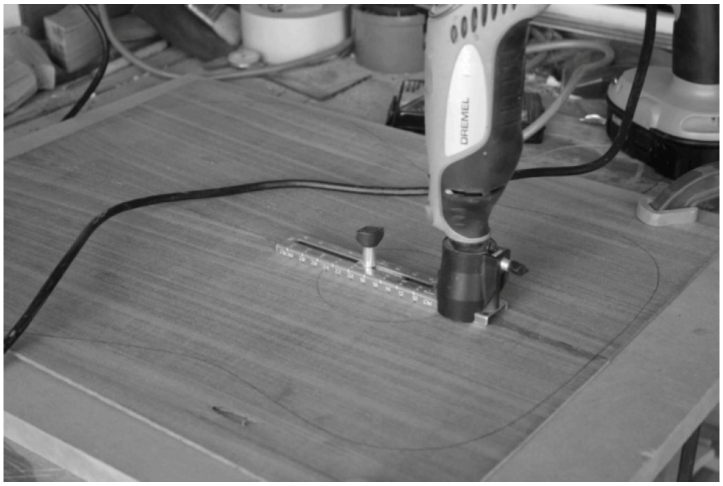
Also, when gluing the braces, try and wipe up any squeeze out right after each brace is glued to the plate. It will be impossible to wipe out any glue at all once there are twenty clamps on the plate, so this must be done right after each brace is glued in.

Any remaining glue that dries to the wood can be removed with a sharp chisel once the carving begins, always being careful not to ding the back plate where it will be seen through the soundhole or near the label.

THE THREE RING ROSETTE

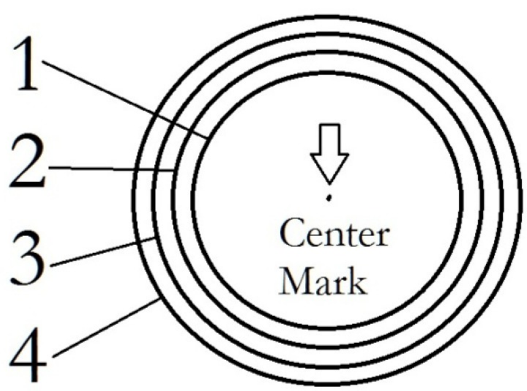
A mainstay of acoustic guitar design, especially the dreadnought guitar style, is the three ring rosette. It is a classic look that is easy to install and it enhances the look of the soundboard. Plus, it is made from purfling strips, so the cost of the inlay is very low when compared to other inlay types.

This Sapele guitar was made with a three ring rosette inlay, though at first the wild stripes of the wood grain hide it. Once a closer look at the guitar is had, it comes out, and in this case is a subtle addition that makes the guitar more attractive.



The easiest way to carve out the cavities for the rings is with a Dremel tool and a circle cutting attachment. The standard Dremel tool has an optional accessory that the tool screws into. There is an adjustable pin on a slide that can be changed to whatever diameter circle is required. The pin is 1/8" thick, so drilling a 1/8" hole for the pin to go into is all that has to be done for clean and accurate circles.

There are other methods of cutting out a circle, like the metal circle cutters that go into drill presses. These will work for this task, however the chance of getting something wrong increases because they have to be used twice as many times as the Dremel, to get the same number of holes. The Dremel will carve out each ring and it will be the correct width when done. The circle cutter on the drill press will have to be set up for the inside of the first ring, then again for the outside of the first ring. Finally, after that the center waste material will have to be chiseled out by hand. It is not an impossible task, however using the Dremel is far easier.



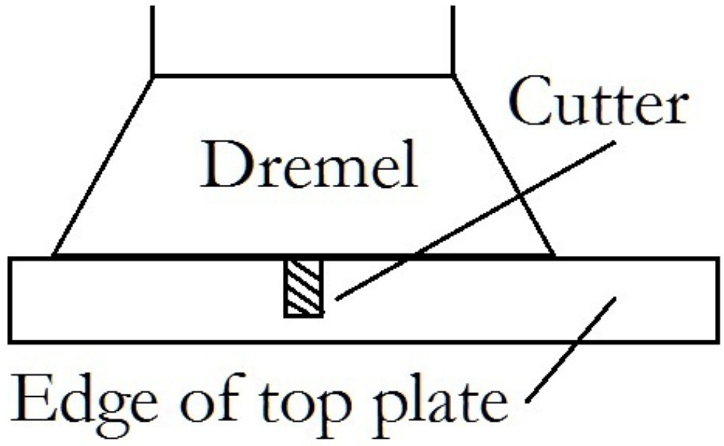
First, draw the body layout on the guitar using a template or any other method. Then, find the location of the soundhole, and mark its center with a dot. The location of the center dot will be different depending on what plan is being followed.

Measure from the dot towards the neck area, and make a mark at 2". This is the radius of the soundhole that will be cut out later. Next, mark another dot on the center joint in the neck area of 2-1/4", 2-1/2", and 2-3/4". Each of these marks is the radius of a ring that will be cut out by the Dremel tool so the purlfing can be inlaid.

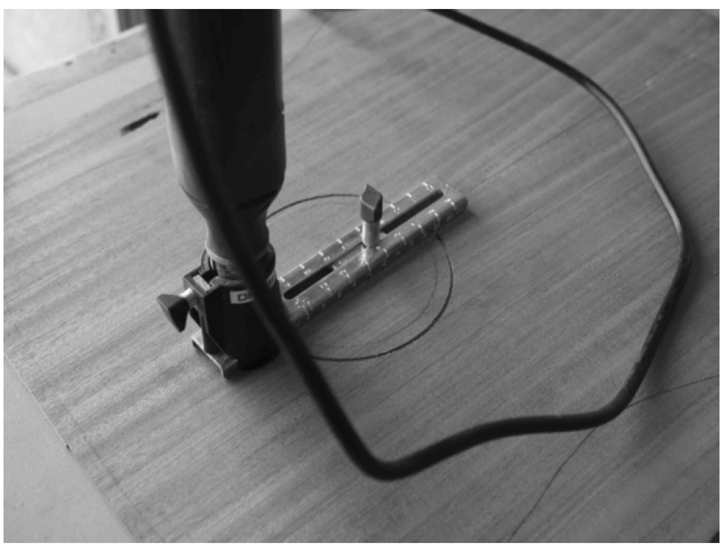
The reason all of the marks are made on the center joint and where the fretboard will be, is because this is the area where the Dremel tool will be inserted into the wood, which can sometimes not look very clean. In the end however, it will not matter because this area will be covered by the fretboard and will never be seen.

Once these points have been marked, it is a good idea for first timers to take out a compass and make circles using the center point as the pivot. Take each mark all the way around until it is a nice even circle. This will help to visualize the project as well as check for errors in measurement that might be hard to see only looking at dots. Plus, it helps while cutting out the circles to see if the tool is removing the wood that it is supposed to, or if it is out of alignment somehow.

The next step is to set the cutter depth on the Dremel so the channels are dug deep enough, but not so deep that they go through the top. The cutter being used in this case is a carbide spiral cutter that is the same width as the purfling to be installed. These are available from a number of retailers, and though they are expensive for what they are, they will last a very long time. Carbide cutters are designed to cut through metal, so they do not even notice when they are used to cut wood.



The easiest way to set the cutter depth is to line it up against the edge of the soundboard being inlaid. Set the Dremel and the circle cutting attachment upright as if it were being used, and look at where the cutter contacts the edge of the plate. Adjust the cutter depth so that the trench is about 2/3 of the way through the plate. As long as the top has been brought down to the same thickness everywhere, then the cutter will not go through the piece when the rings are dug out.



Look at the center pin on the Dremel, and drill a hole through the soundboard one drill size smaller, and see if the pin can be eased into the hole without too much force. It should go in without too much trouble,

and will make for a nice and tight fit that will help prevent the tool from being dragged around while cutting the rings.

Set the size of the circle to be cut to the size of the first ring that is closest to the sound hole. Be sure it is not the very first mark, which is the guide for cutting out the actual opening for the sound hole. Check this measurement a couple times to make sure it is lined up with the mark in the fretboard area while the pin is in the center hole. Once satisfied, turn on the tool, and press it into the surface of the wood. Turn the jig about half an inch and then without removing it from the wood, turn off the tool. Allow the spinning to stop completely before removing the jig from the top of the plate.

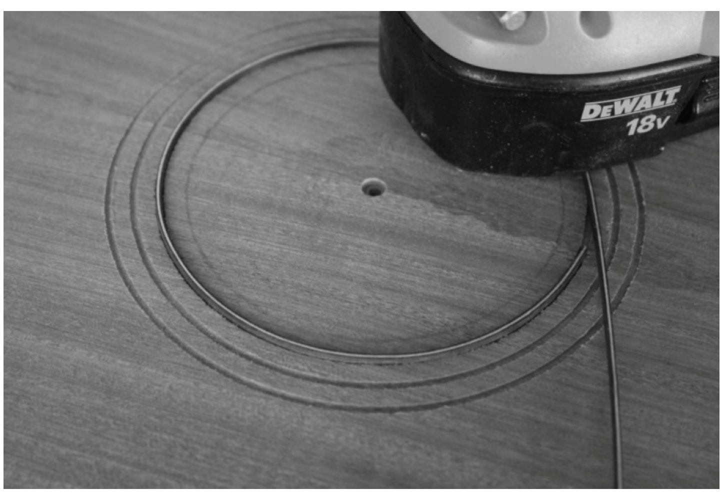
Inspect the small channel that was dug into the wood to see if it is accurate. Check the depth of the slot as well as the placement, to see if it is on the line that was measured earlier. If it is not, adjust the jig to correct it, and cut another half an inch of fresh wood, still under the fretboard area where it will never be seen. There is enough wood to cut and adjust about four times at most, though it would be really rare that so many adjustments would ever be needed. If there is a constant problem with things getting out of alignment, check the jig itself and make sure the tools are not the problem. Check that everything is tightly screwed together, and that the tool itself is in good order.

Once the test cut looks good, replace the jig back in the center hole and let the bit stand in the slot that was cut. Turn on the tool while the bit is in the slot, and begin to slowly make the circular cut. It does not matter which direction the jig is spun, the spiral cutter seems to do about the same in either. The important part is to keep moving to avoid burning the wood, but to not go so fast that the tool jerks and makes concerning sounds. The cutting sound will be loud enough, however if other louder and more alarming sounds start coming from the cut, that means slow down. It should take about 30-60 seconds to make it through each cut, with the larger rings taking a little more time obviously. There will be a difference felt as the cutter goes through the different grain orientations, and the tool will try and pull or push depending on the density of the wood sometimes.

The times that the cutter goes with the grain, it will be smoother and quieter. These are normally at nine and three o'clock when looking from the neck attachment area. The cutter will drag and need to be handled extra carefully when it goes through grain perpendicularly, such as in the areas of

twelve and six o'clock looking from the same place. Go slow, and a nice clean cut will result.

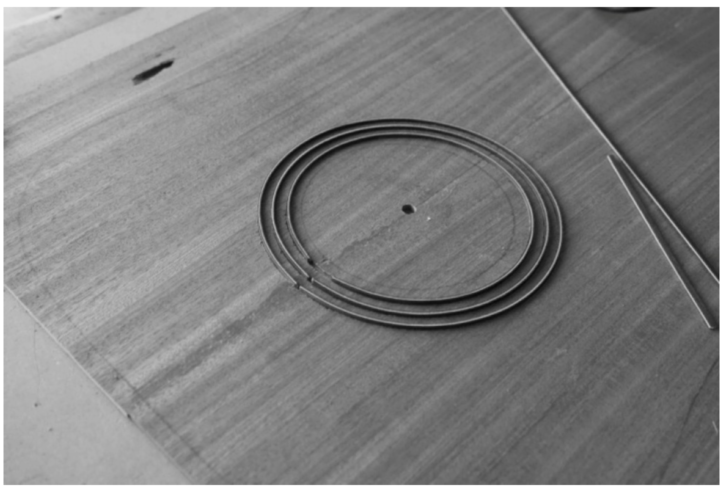
Proceed with the next two cuts in the same way as the first. Test each one before making the final cut, and take the cut slowly so it is even and straight. Remove the tool, blow off all the dust, and check to see how the trenches came out. If all was well, they should have sharp straight walls, be evenly placed, and have graceful arcs without lumps.



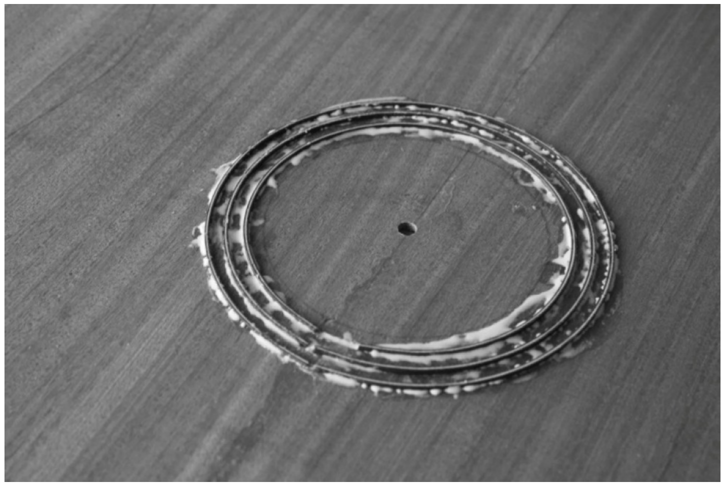
The next step is to take the purfling and start test fitting and cutting it to the correct length. The inner circles will require shorter pieces than the outer circles, and each piece will need to be test fitted and cut. The ends do not need to meet together perfectly in the neck area because they

will be covered, so measure and cut a piece that will get them within 1/4" of touching once they are glued in place. If they are a little closer or a little farther apart it is not a big deal, just make sure all the gaps are in a place where the fretboard will be covering them.

It helps to use a heavy object like the drill in the above picture to hold the strips in place while test fitting and measuring them. The purfling strips tend to be springy, and are sometimes hard to hold steady. They do not however need to be heat bent at this stage because the curves are not tight enough that the strips could break.

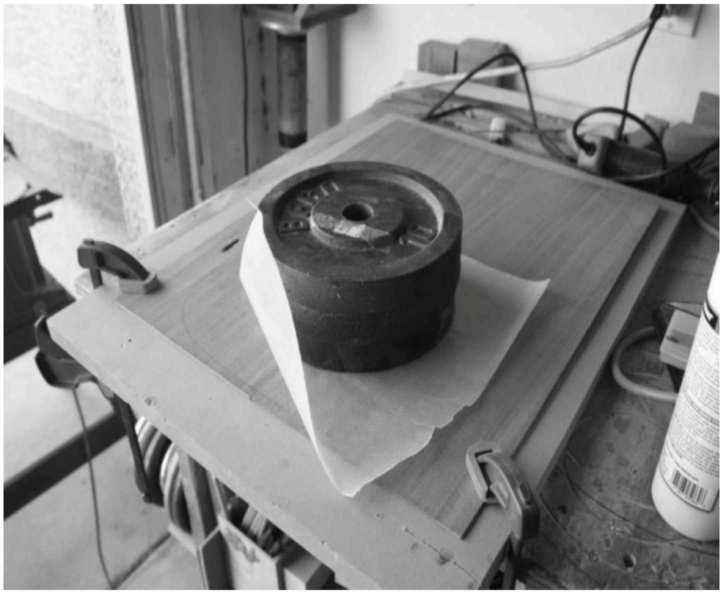


Once all three strips have been laid into the channel, they can be checked for gaps that may have been accidentally created while cutting the holes. Gaps can be filled with sawdust and glue later on, though they will still be seen when the rosette area is looked at closely. If the area looks good, remove the three pieces, keeping them in order, and get ready to glue them in place.



Fill each circle one at a time with wood glue, using the applicator tip to help get the glue deep into the slots. Starting at the under fretboard area, begin putting the strip into the slot. Follow with a hammer as the strip goes into the slot, to make sure it goes as far down as it can. This will cause a lot of glue squeeze out, which is good, and will help fill the channel as well as any gaps.

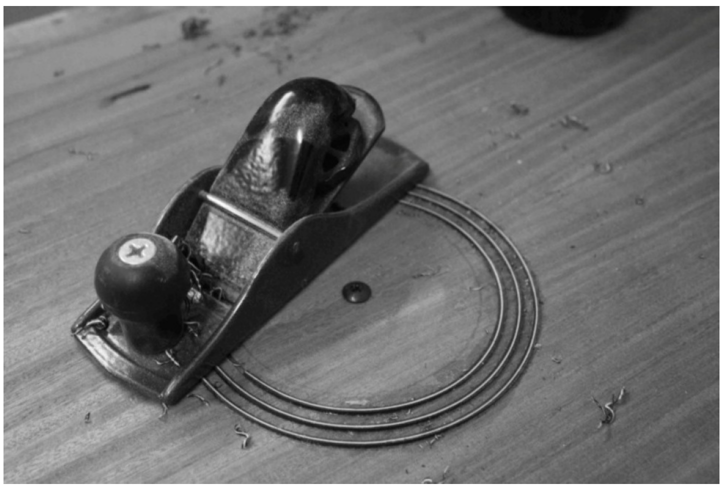
Proceed with the second strip in the same manner, applying glue first to the slot, then hammering in the strip as it is worked around the circle. Inlay the third strip the same way, and then wipe off a portion of the glue. Do not worry about getting every last drop, instead get the really messy parts and leave the rest. If all the glue is washed away, the inlay might show gaps. A little extra glue to scrape off later is well worth a nice looking inlay.



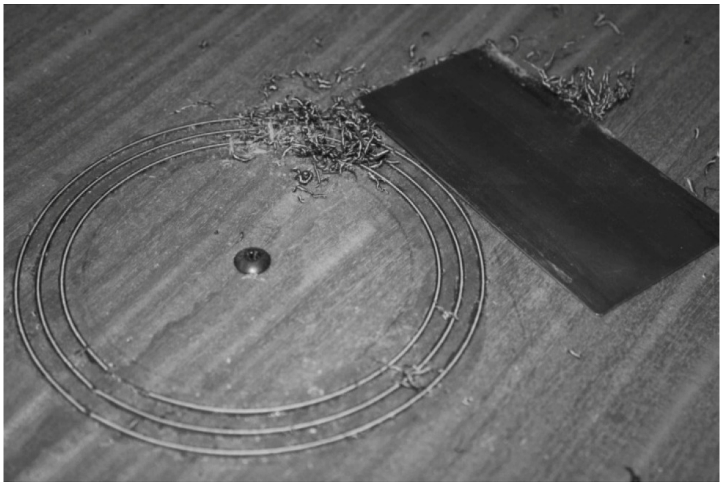
When some of the glue is wiped away, cover the rosette with a piece of wax paper, and then place a flat piece of wood over it. The board needs to be big enough to cover the entire rosette so there is no chance a piece will pop out as it dries. Place weights on top of the board, in this case 30lbs, and let it dry completely overnight. This area will be carved in the next steps so the glue has to be completely cured before it is worked into shape.

Remove the weights, the clamping board and the wax paper the next day and check on how everything dried. If there are any gaps that need to be filled, it is easy enough to make a paste out of sawdust from the top and some wood glue, and fill in the gaps that way. There are instructions for this technique in chapter seven, which will be the best chance of it matching, and the best chance of it not being seen very easily.

After satisfied with the look of the rough rosette, it is time to move on to planing it down and making it level with the surface of the guitar.



Starting with a very sharp hand plane, remove as much of the waste material from the purfling as possible. Do not go so deep as to begin removing material from the surface of the guitar top however, and do not be too aggressive. Taking several shallow passes with the plane will be much easier to control than taking a few deep ones, and the risk of ruining the top is greatly reduced. Clamp the top to the bench while doing these steps to help keep it steady. A small screw that is sent through the pivot hole area will also help keep the wood stable. Do not change the size of the pivot hole however, because it will be needed again to cut out the soundhole.



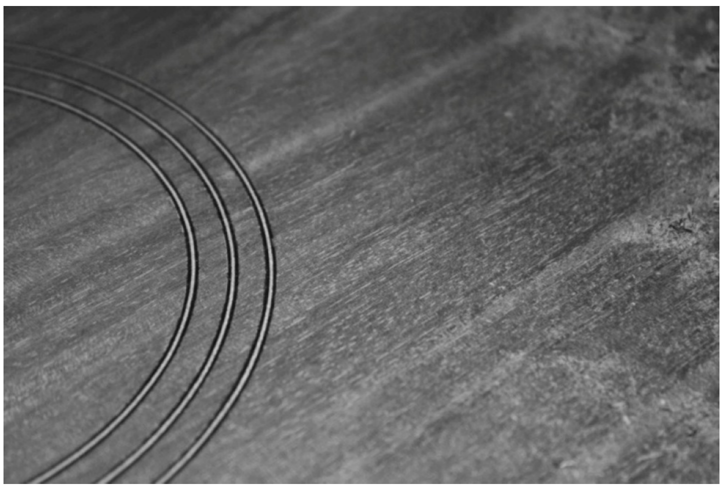
After the plane has removed all that it can from the surface, a scraper blade is brought in to do the final leveling. A scraper works really well with the purfling, and slices through it cleanly. How to use and set up a scraper is covered in chapter three, and is a very handy item to have.

The rosette can also be leveled with a sanding block and sandpaper, though it will take a little longer than if using a scraper. Start with 100 grit paper to do the heavy lifting, then switch to 150 grit, and finally 220 grit. The last passes with the paper need to be done in the same direction as the grain on the top, so the sanding scratches are hidden.

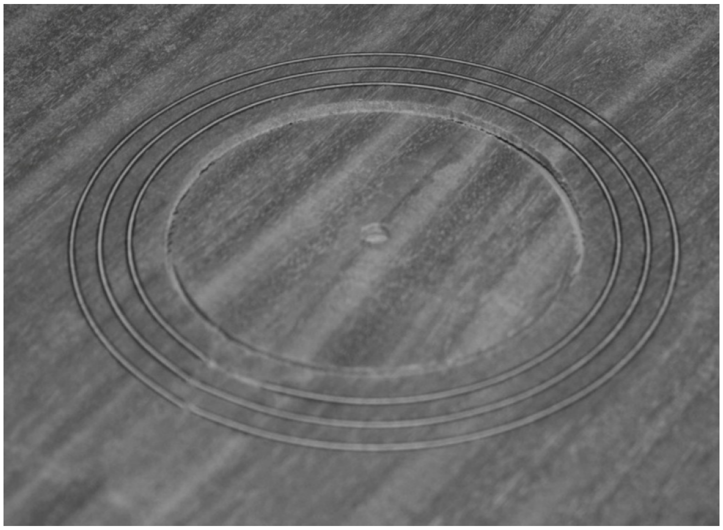
The above picture shows what the final look of the rosette should be once everything has been scraped level to the surface. It is important to check the work often as it is being done to make sure there are

not any valleys being carved into the wood. It is easy to keep cutting the same place and following the ring around the circle until a small indentation is carved into the surface. Use the cabinet scraper to cut over several rings at once, and go in several different directions. This will decrease the chance to create a depression, and make the rosette area more level in the end.

As a final check, especially for those new at working a cabinet scraper, a large piece of flat wood and sandpaper can be used. Cover the piece of wood with 220 grit sandpaper, and lightly go over the rosette surface. The objective is to use light pressure and remove all the high spots that were left from the leveling process. Once this is done, take a few passes in the direction of the grain to hide any sanding scratches.



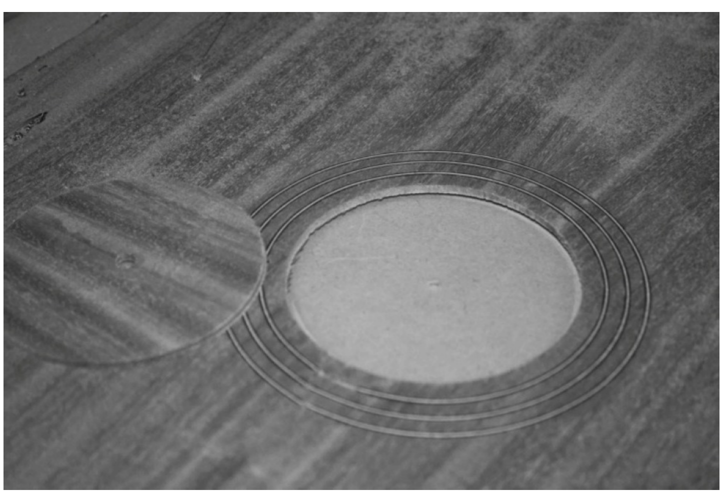
Here is another look at the finished rings as they are inlaid on the Sapele top. Sanding them helps make the surface more uniform, and leaves a professional look to the guitar top.



The last step after everything has been smoothed out is to put the Dremel and circle cutter back in position, and line up to cut the soundhole out of the center. The carbide cutter needs to be lowered enough that it makes it all the way through the wood for this operation, and having a piece of scrap wood below the top helps avoid tear out.

Make this cut carefully, because the place where the cut is started can sometimes be seen depending on where the fretboard ends up landing on the top. It can be sanded afterwards to remove any issues, but it is much easier to start with a nice looking and evenly placed hole.

When the cutter reaches the starting point again after cutting out the soundhole, carefully reach up and turn off the tool. Once it has stopped it can be lifted out without worrying about damaging the top on accident.



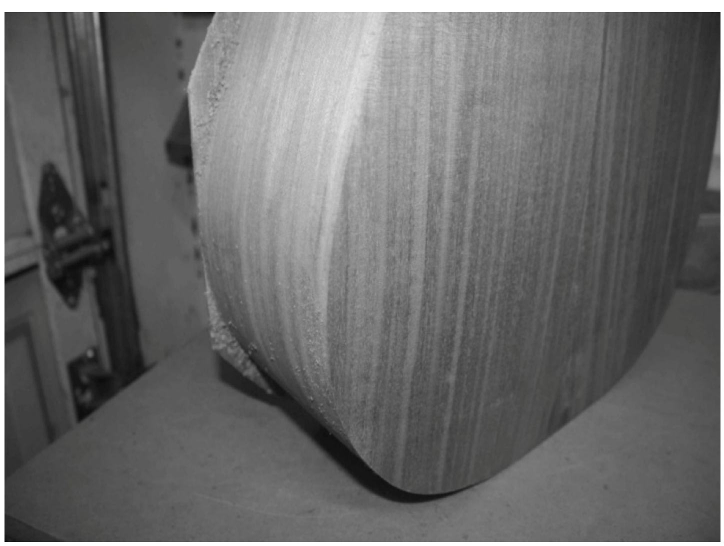
Remove the piece after it has been cut, and use a piece of sandpaper to clean up the rough edges and smooth everything out. The corners of the hole need to be rounded slightly, and any irregularities in the shape of the circle need to be sanded out. The rosette is now completed.

TRIMMING PLATE OVERHANG

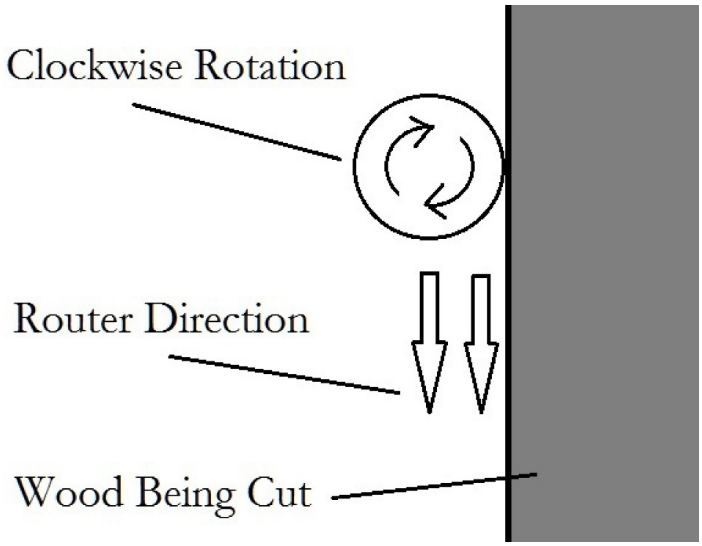
When the plates are glued to the sides, there is always a little bit of overhang around the edges. This is because the plates are made oversized so that they can be glued without worrying about if they will fit or not. Once the soundbox is assembled, the overhang needs to be removed.

The picture above shows the body with the plates glued on, and how the overhang will look after the guitar comes out of the mold. Many guitar making books recommend using a chisel to remove this excess, however there are many better ways. A chisel is a tool that requires time and practice with, and can really ruin a top or back if it causes a split along the grain. A router on the other hand, if ran correctly, will trim the overhang with a minimum of danger.

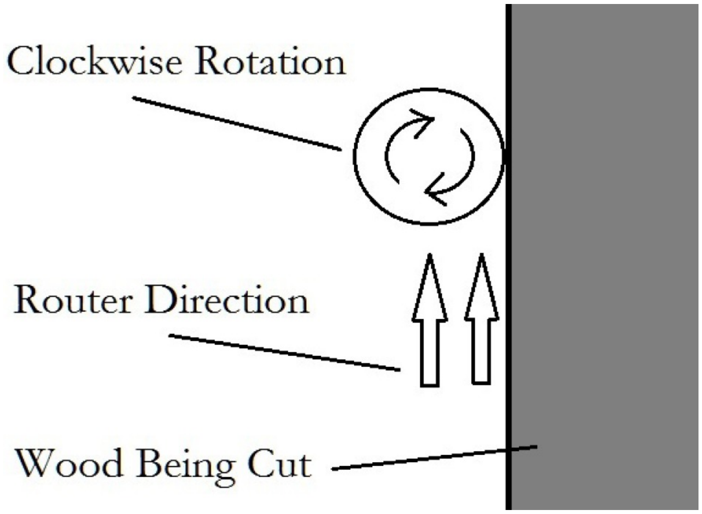
A router with a flush trim bit is the best way to trim the plate overhang, and get a nice even corner to rabbet the ledges for binding later. The flush trim bit has two blades on the straight sides with a bearing on the bottom that causes the cutter to trim evenly with whatever the bearing touches. In this way it can be ridden along the side of the guitar, and it will cut the top overhang to the same profile. Whatever shape the bearing follows, it will cut the top or back to match, which is way easier than doing this by hand.



The trick to staying out of trouble with the router, is to always be making a climb cut with the direction the router is moved around the body. A traditional cut has the router bit spinning towards the piece being cut, almost fighting against the motion of the router. A climb cut goes the opposite way, where the bit digs into the wood, trying to pull the router faster.



The diagram above shows the traditional cut made by a router as viewed from above. The rotation of the router bit is clockwise, meaning it will dig into the wood as it is moved downwards across the piece in the diagram. Downwards would mean more of a movement towards the body when routing something, but it shows how the bit is taking material more aggressively.



With a climb cut, as shown in the above diagram, the direction the router is being moved is following the direction that the router bit is spinning, which controls the cut more. Shallow cuts need to be taken because the router will want to grab the wood and pull itself (and the operator) faster than a traditional cut. However, making nice and shallow passes with the climb cut will help avoid tearing out a large chunk of the guitar top.

A very shallow and controlled climb cut prevents accidental tear out, and as long as it is shallow, will not catch and drag the router either. In this way, wood is sheared off without taking the chance of digging into the grain, which can cause the wood to split.

Clamp the guitar body down to the workbench, taking care to protect the top and back with a rag or clean shop towel (old wash towels and hand towels work great for this). Set the flush trimming bit in the router so it extends deep enough to touch the sides, but not too far past the plate being trimmed. The cutting part of the bit should line up with the plate overhang.

Turn the router on, and carefully begin moving it around the guitar in a clockwise direction, which on most routers will be a climb cut. The bit should be spinning in the same direction as the router is being moved around the guitar when viewed from the top, and that will be a climb cut.

Slowly begin to take off material, working around the guitar. Do not take a deep cut, because the router can get away and dig into the wood very quickly. Take slow and easy cuts, removing 1/8" or so at a time. After a few passes, the router bit will be able to touch the sides, and this will create a perfectly cut top and back plate to match the side profile.

If the back plate is arched downwards towards the upper bout like on most guitars, the router may have a hard time reaching the corner where they meet. This will result in the little bit of overhang that can be seen in the above pictures. This is not a major problem, and can be dealt with very quickly with a large wooden block and some 80 grit sandpaper. It is hard to scrape end grain without making a wavy mess, so it is recommended to sand instead.

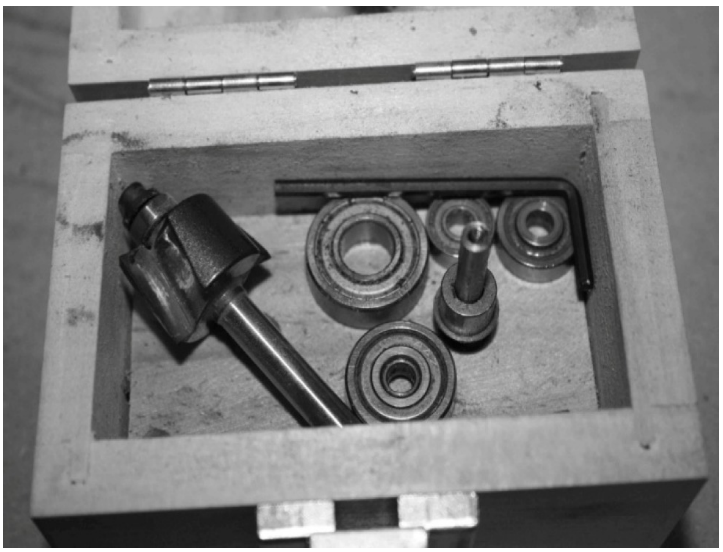
Thinking in a different way than most of the books, it is clear that this job can be done with a number of tools. The router obviously, a spindle sander would work, or a drill press mounted sander, a belt sander, or a router table. There is always more than one way to do something, and it is a matter of finding out how to do it differently.

Once the plates are trimmed fairly well, they can then have the ledges routed in place with a rabbeting router bit. A rabbeting bit uses a cutter and bearing similar to the above flush cutter bit, however the bearings can be changed for larger or smaller diameters, which change how deep the blades are allowed to cut.

A basic rabbeting set is covered in the next section and is an inexpensive way to tackle the job of making the ledges for adding binding and purfling to the guitar.

RABBETING ROUTER BIT SET

There are several very expensive router bit sets that are made specifically for guitar makers, for installing binding and purfling. These bit sets are really just a rabbet bit set with very specific bearings that cut the exact same size as the binding and purfling being installed. A standard rabbet set with several bearings will do almost the exact same thing, plus or minus a couple thousandths, and be less expensive.



The set usually comes in a small wooden box as seen in the above picture, and it will have a main cutter bit which is on the left, and several different diameter bearings on the right. A small hex key is used to loosen a screw for bearing changes, and the post they are screwed down to lines them up concentrically with the cutter. This means that no matter which side of the router is used, the cut will always be the same depth.

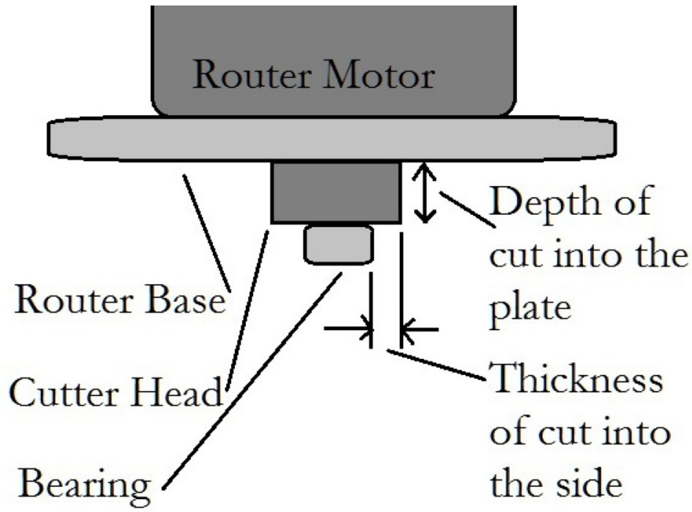
The important thing is to select the right set for installing binding and purfling, as well as the right shank size for the router being used. They will come in half and quarter inch shanks, and have different bearings for different cuts. The two sizes that are the most important are the 1/16" and the 1/8" inch rabbets. The 1/16" can be used for any binding

strips being installed, either store bought or shop made. The 1/8" rabbet is for a thin piece of purfling and a binding strip.

The 3/16" and 1/4" rabbet bearings are nice to have as well, because they will allow a larger piece of purfling to be used, such as a herringbone, which can vary in width from 1/8" to 3/16" itself.

If a binding strip is being used alone. the 1/16" rabbet is perfect because it leaves enough of the thickness to be seen while looking at the top, and just enough to be able to trim it all flush with a scraper after the binding strips are glued in the rabbets.

When chucked in a router, the rabbeting bit looks like the above picture. The cutter head is below the bearing, and the bearing lets only a certain amount of cutter stick out past the edge. The bearing is what determines the thickness of the cut, while the router base plate determines the depth.



For binding only, select the bearing that will make a 1/16" rabbet, and screw it to the cutter head using the hex wrench. Place it in the router and get ready to set it for the size of the binding being used on the guitar.

The router bearing is what determines how far into the side of the guitar the cutter head can go, which should be a little thinner than the binding strips, to allow for overhang to trim flush later. The amount of the cutter that comes out past the router base will determine how deep the shelf will be, or how tall the binding will be. If the binding is 3/8" tall, set the cutter so a tiny fraction less than that is exposed past the plate. This will set the second measurement.

Route a test piece of wood and check it with a binding strip to make sure the ledge is both deep enough and tall enough, and re-adjust if necessary.

The following section will show how to install binding and purfling on a guitar using the rabbeting bit, and what order everything should be done in.

INSTALLING BINDING AND PURFLING

Binding the body of the guitar serves a few purposes other than simply being a way to dress up the instrument, though it does this well. The binding covers up the butt joint between the top/back plates and the sides, concealing it from view. Also, the plates show end grain at the head and tail with this type of joint, and if not covered up, they will absorb finish a little differently. The problem with this being that the coloring on the guitar will never quite look the same in those areas. Finally, adding binding is a chance to express some creativity and show off the beauty of a contrasting natural wood species. Binding can be made from just about any bendable wood, and is a great opportunity to showcase an exotic species.

To begin routing the ledges for binding, the guitar body must have the plates trimmed flush with the sides, as described earlier in the chapter. A rabbet bit set for the router which is also described earlier will be used to create the binding ledges in this example.

Before any of the routing can take place, the end flash needs to be inlaid. This can be as simple or as elaborate as desired, however in all cases it still needs to be installed first. The reason for this will be clear once the ledges are routed. It is much easier to rout through the end flash to trim it to length than it is to carefully inlay it on all four sides. The two long edges are the only things that need to be right with this method of inlaying the flash. Once the router comes along and cuts the ledges, it will also cut a nice straight edge on the ends of the flash.

In this example, the end flash will be a single piece of Maple binding, which is the same species being used around the rest of the body. A simple piece of flash conceals the joint between the sides at the bottom of the guitar, and has a thin traditional look.

Hold a small piece of binding strip on the bottom of the guitar, and use a razor knife to score a couple lines on each side of it. Get these lines right up against the strip, using very light pressure until the lines are deep enough to press a little harder.

Once the score lines have been made, take off the binding piece and score the lines a little deeper and a little harder. The goal is to make a deep enough score line that when the router or Dremel gets close to it, the little bits of wood fall away, leaving a nice clean wall for the inlay.

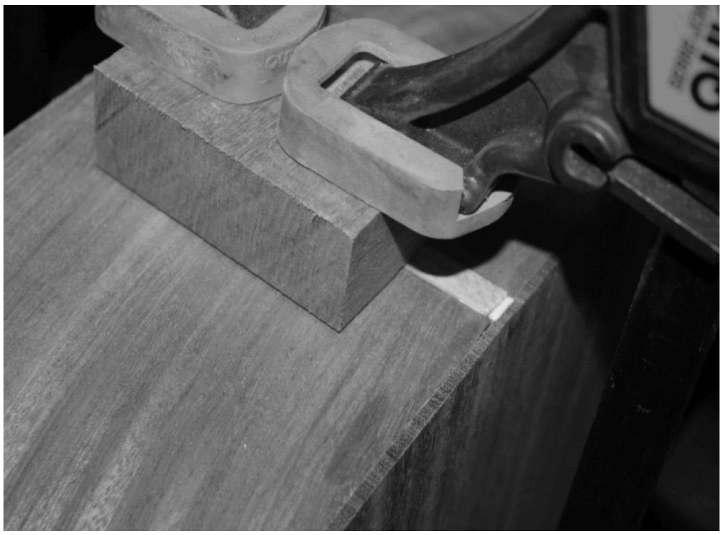
Use the Dremel or a router, and carefully remove a little less than the same depth of material as the thickness of the binding strip. This will leave a little behind to trim flush later on.

If the binding strip is a standard width, like 1/4," or 3/8," a single flute can be used in the router to cut the inlay cavity in one pass. Chuck the bit that is the same size as the binding strip, and clamp a rail on the bottom of the guitar that the router plate can ride against to make a straight cut.

Measure where the router bit needs to be for the binding strip, then clamp the piece of scrap wood being used as a guide to the bottom of the guitar, so the cutter is lined up and the plate touches the rail. Turn on the router and make a single pass to remove the material.

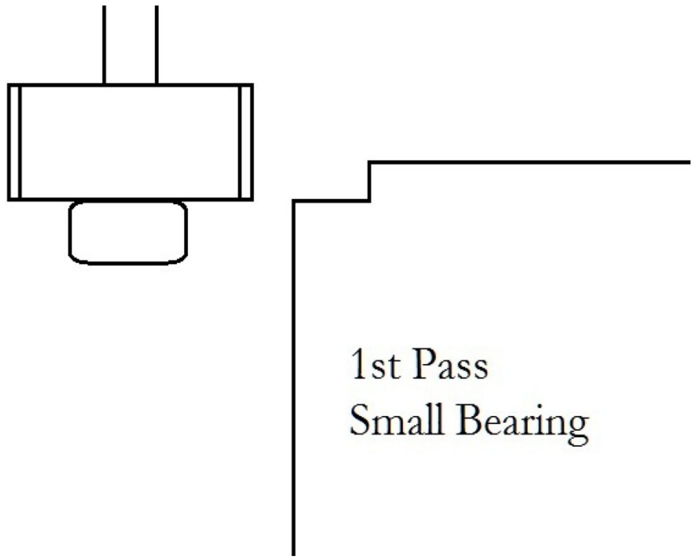
Once the material has been removed, the end of the guitar should look like the above picture, depending on what size and shape of end flash was routed for. Going through the plates is not important, and if using

a router it is much easier to just go through both plates when making the pass. That area will be routed again with the rabbets anyway, so it does not matter. The reason the plates were not gone through in the above picture, is a Dremel and router base were used, which is a tedious process, so only the material needing to be removed was cut away.



Test fit the inlay piece and see that it fits snugly but does not need a hammer to be inlaid. Put glue into the cavity, making sure to coat the walls of the cavity as well as the bottom. Place the end flash into the cavity, using a clamp to hold it in place while the glue dries.

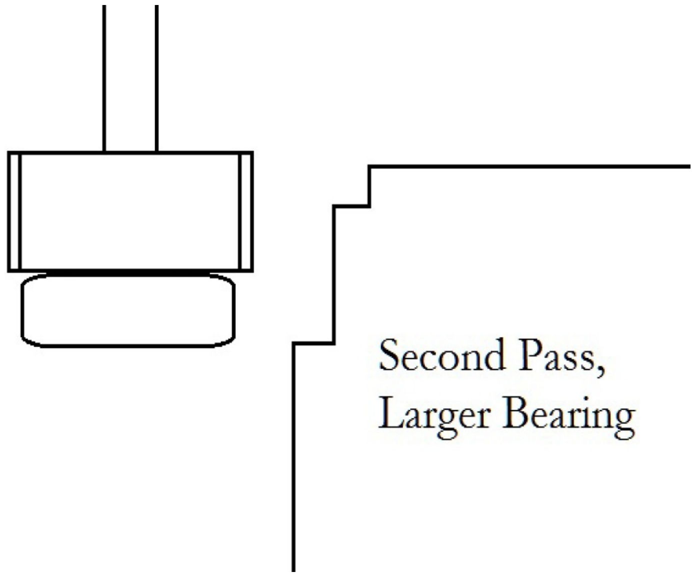
Once the glue has dried, the clamps can be removed, and the process of routing binding ledges started. The next few diagrams will show what the process looks like on paper before going at it in real life. Understanding the process before beginning it will make a big difference in whether or not the guitar ends up beautifully bound or in the scrap bin.



The routing process will be done in two passes, because both binding and purfling are being used in this example. If only binding is being used, only make the second cut being shown here.

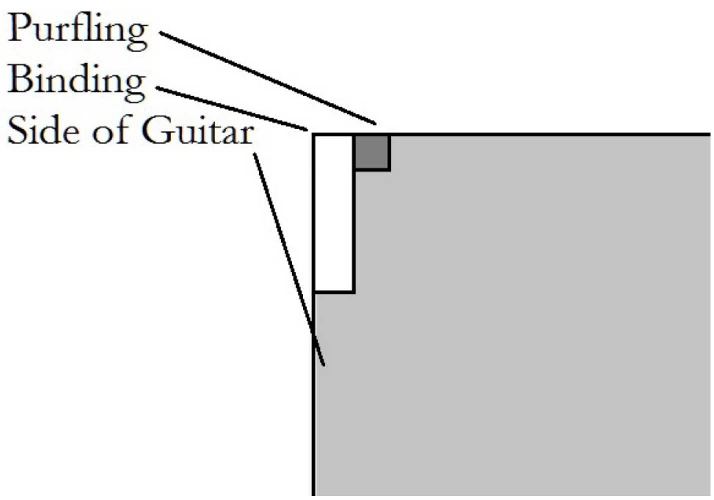
The first pass of the router is with the 1/8" rabbet bearing, which will make a ledge big enough for the purfling strip being used, as well as room for the binding strip to lay against it. The purfling in this case is 20/20/20, which is just a few thousandths smaller than 1/16," and will fit well once the second pass removes another 1/16" from the original cut.

The height into the top of the guitar is determined by how tall the purfling strip is, though usually getting 1/16" to 1/8" deep will work in most cases. Do not go too deep because there is no need to go all the way through the top with the purfling strips.



The second pass with the router is for the binding strip, and is used with the 1/16" rabbet bearing in place. This cut reduces the 1/8" width of the original cut by half, making the perfect small ledge for the purfling strip to sit on. Also, it cuts out the space for the binding strip to be glued into.

The height of this cut needs to be just slightly shorter than the binding strip height, which will allow for some trimming later. Again, the depth is fixed by the bearing being used, and cannot be adjusted except by changing bearings. The height of the cut can be changed by retracting or extending the cutter past the router base. In the diagrams on the previous page, the term height refers to the cut up and down, and the term depth refers to the cut left to right.



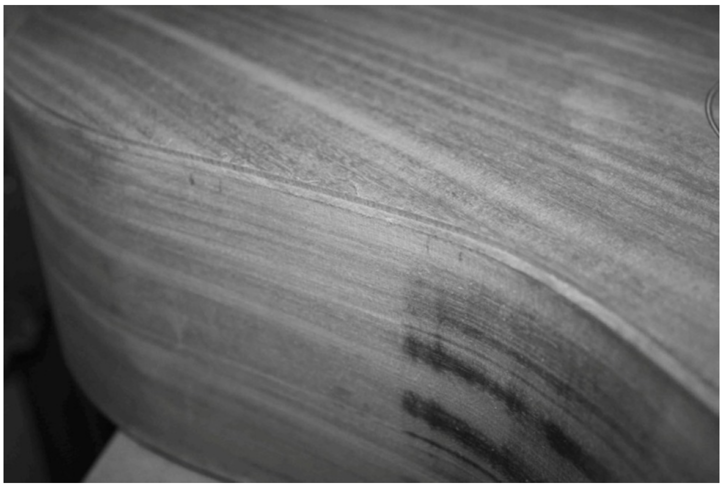
This view shows the edge of the guitar with a binding and a purfling strip installed. The smaller ledge that was created with the first pass of the router is held in place by the binding strip on the outside, and the wood of the guitar on the inside. The binding strip fits over all of this, creating a clean looking edge around the body.

Though the binding and purlfing strips can be glued in at the same time, it is recommended to glue the purfling strip in first, then the binding strip. This just makes the job easier and cleaner because there will be lots of glue, tape and a little fighting to get the strips to lay down nicely.

Route the first pass as in the previous diagrams and the above picture. This will be the larger of the two passes, and as deep into the side

as the combined width of the binding and purfling strips. In this case 1/8" deep.

Clamp the guitar down on the bench using a towel or something soft under the faces in order to keep from marring them. Clamp the guitar in place well enough that the router will not move it around while cutting. Make the first pass creating the larger ledge as far as the router can go before contacting a clamp. Once this happens, turn off the router, rotate and re-clamp the guitar to begin cutting again.



Work on one face of the guitar at a time, going completely around it before going to the other side. Inspect the route as it is being created to make sure the depth is uniform, and the ledge looks right. If the bearing is kept well against the side of the guitar, the ledge should be very even and clean. If a second pass is needed to clean up any unevenness, make it carefully, and it should help trim everything up.

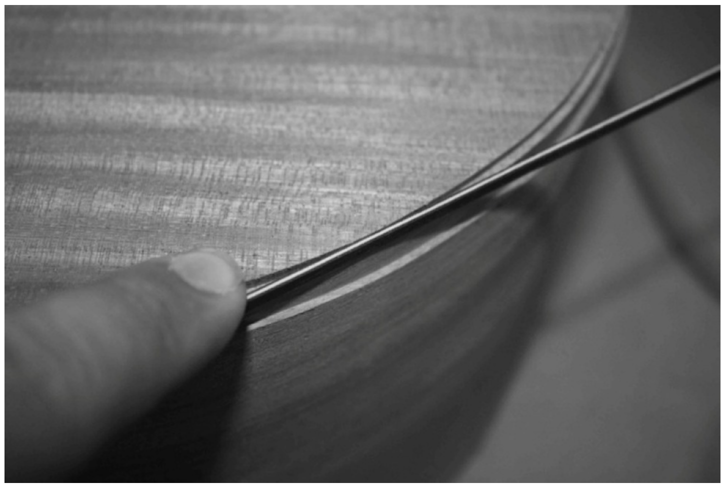
Flip the guitar over and repeat the procedure on the other side, making the first pass which is the larger of the two.

The second pass is done the same way as the first, changing the height, and the bearing is swapped out for the smaller rabbet of 1/16." Clamp the guitar down to the bench just like earlier and make as large of a cut as possible. Re-clamp the guitar to expose new edges that need routing, and rabbet them as well.

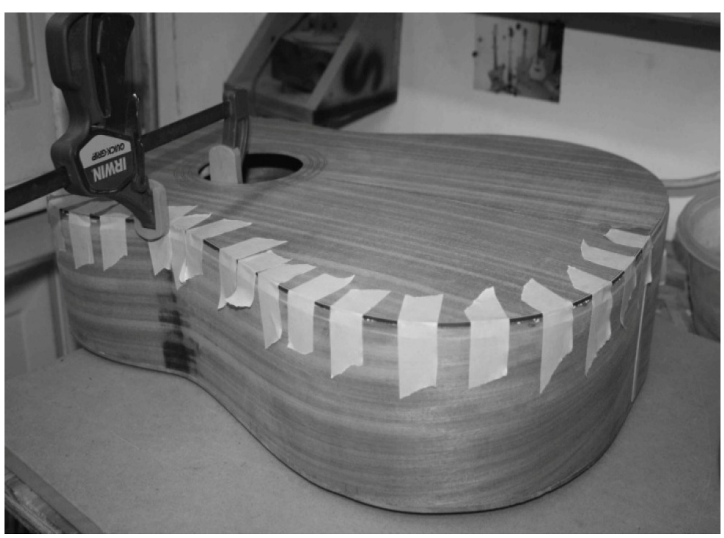
When rotating the piece and clamping it down, make sure to leave a little overlap between the two passes so they look more uniform. The ability to start in the last ledge and then blend it into the new area will make the overall job look better.

Flip over the guitar once one side has been completed, and route the other as well. Check the rabbets for consistency and evenness, and address any areas the need it.

Along the back of the guitar at the neck area, the router plate may interfere with the slots getting deep enough. If this happens simply use a wooden block and sandpaper to trim it the rest of the way. The curve on the back plate will sometimes prevent the router from getting to the full depth, however it will always get most of the way. Follow these lines with the block and sandpaper, and bring them to the right depth.

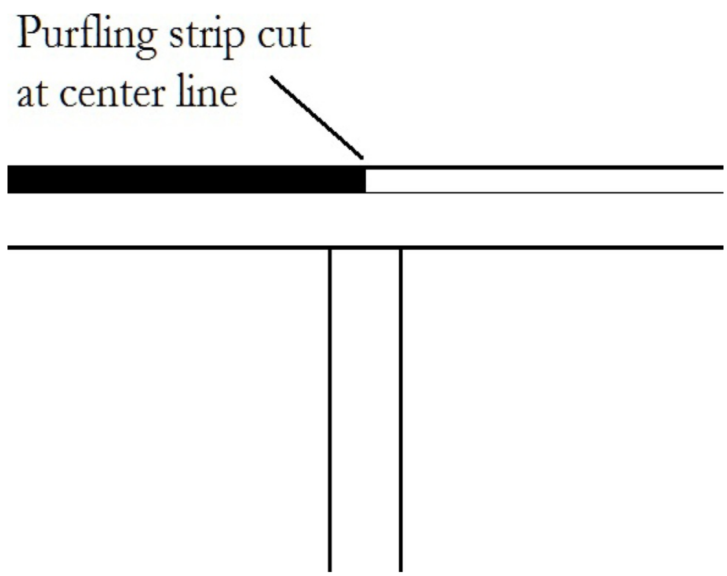


To check the accuracy of the ledges, use a piece of purfling and test fit it on the small upper ledge. The piece should fit well, and be basically flush with the wall of the second rabbet. This would mean in our example that the purfling strip is 1/16" thick, and it is sitting on a 1/16" to 1/8" deep ledge, which is a perfect fit.

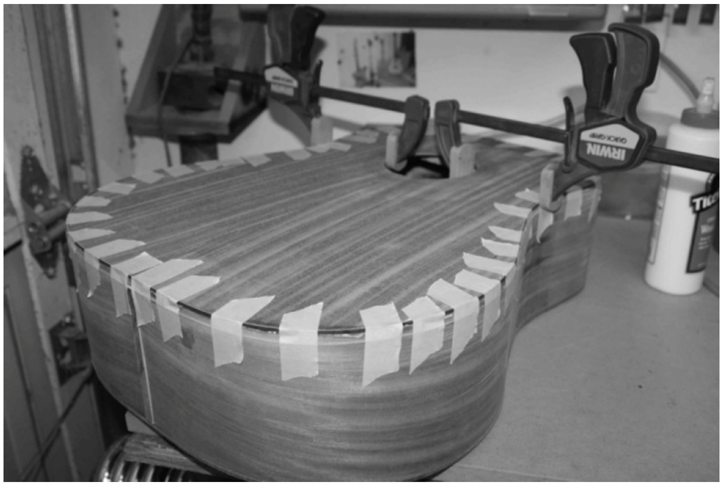


Apply glue all the way around the small purfling ledge, working on one side at a time. Using several pieces of tape, begin taping the binding strip into the small ledge, allowing a little overhang past the bottom and top center lines. This will be trimmed before the other strip is glued in, making a nice looking meeting of the two strips at the top and bottom of the guitar.

The tape being used should be good quality masking tape, or blue painters tape. Both of these will hold well, but not so well that they tear out grain when they are removed.



The above diagram shows the end of the guitar, and how to trim the purfling strip after the glue dries. Use a chisel to make this cut, going straight into the strip right at the center line of the guitar. This will need to be done at the top and the bottom before the second piece of purfling is installed.



Once the ends of the first purfling strip have been trimmed, glue the second one in place. Start at the tail by butting up the end of the new strip right against the end of the old one. This eliminates having to cut one joint immediately. Follow around bending the strip in place and adding as much tape as necessary to hold it. A clamp or two, placed in the soundhole area can help to hold the harder bends in place while the glue sets.

When the end of the purfling strip is reached, carefully trim it to match the existing end, and tape it down as well. Take care to get this joint correct, because too short of a strip will leave a gap, and too long will cause a bulge. Use a chisel or a set of cutters to trim the end slowly until it fits well.

Once the one side has been completed, flip the guitar over and do the other side in the same manner. When the glue dries, remove the tape carefully, and clean up any squeeze out with a chisel, scraper, or sandpaper.

Getting rid of the glue squeeze out is absolutely the most important thing that can be done before the binding strips are installed. A small chunk of glue will force the binding strips out a little bit, which will cause a gap in the resulting glue up. Take the time to remove the excess glue, and the process of binding the Maple will be much easier. A well sharpened scraper will make short work of removing this extra glue, and so would a piece of 150 grit sandpaper held against a wooden block. Once the ledges are clean, the binding can begin.

Before they can be installed, the binding strips need to be bent on a hot pipe to the shape of the guitar sides. The bends that need to be as accurate as possible are the upper bout and the waist. The lower bout just needs to be a long graceful curve and it will be easy to bend it into place later.

Spread glue all along the binding ledge, making sure to get a little on both the wall and the base of the rabbet. Begin with the waist and start taping the binding strip in place. Work from the waist towards the upper bout, leaving a little overhang at the center line like last time.

Go back to the waist and work towards the lower bout, taping and pressing the binding strip tightly against the guitar body. Check along the way to make sure the strip is not coming up, and fix any areas found immediately before moving on. Once the entire strip is taped, it will be difficult to fix any bulges or areas where the binding strip has not been pressed deep enough into the slot.

Use a couple clamps if necessary to wrestle the binding strip in place. The better the job of bending the strip to match the side profile, the

less clamping will need to be done. The binding job in the above pictures just really liked to fight back for some reason, which is why clamps are good to have around.

Once the side dries, trim the binding strips to the top and bottom center lines just like the purfling was trimmed. This will make room for the strip that will be glued on the other side.

Glue the second strip in place in the same way the first one was. Start at the waist and work towards the upper bout, then go back to the waist and tape towards the lower bout.

If the second strip creates problems, use the clamps to get it back into position where it needs to be. When the binding strip gets to the lower bout, trim the binding strip with a small saw or a chisel so that it meets up with the already trimmed strip in a nice butt joint. Take the time to get this joint correct, because a gap or bulge here will show.

At a worse case scenario, a gap is better than a bulge because it can always be inlaid with a piece of abalone or other wood, and it will look intentional rather than accidental. Shoot for the best fit, but if it fails, leave a small gap that can be filled with abalone later. The process would only involve cutting a 1/8" wide sliver and using a hobby knife to make a space for it. The piece would be glued in with epoxy and it would conceal the gap. Again, this takes something accidental and makes it look intentional, which also makes it look nicer than seeing a gap.

Allow the glue to dry for a few hours and then do the same operation on the other side of the guitar, so the whole body will have binding strips installed.

Once the glue has dried, the clamps can be removed and the glue joints inspected again for any problems. At this stage in the game, any gaps will have to be filled with wood filler or inlaid over, because the strips will not be moveable. At a worst case if the binding job moved during gluing or just came out awful, the strips can be routed off using the rabbet kit, and the process can be started over.

Assuming everything went well enough to proceed, and you still have hair on your head after this part of the build, the tape can be removed. Go slowly and carefully so the tape does not remove any of the grain as it is pulled off.

With the tape removed, the binding and the purfling need to be trimmed flush with the body of the guitar. This is a two step process where the top of the guitar is brought level first, then the sides are trimmed using a router and flush cutting bit.

Clamp the guitar to the bench, making sure to protect the face against the bench top with something soft. The reason the piece needs to be clamped during scraping is because it will allow both hands to be used, as well as keep the piece from moving.

If a piece moves 25% for every stroke made with the scraper or sander, it reduces the efficiency of the work to only 75%. Clamping the piece means 100% of the work being done is transferred to the guitar body, making the job much quicker and less frustrating.

Work in one section at a time, leveling the binding and purfling with the guitar top. Move the clamps and pivot the guitar to expose new areas, and continue making them flush.

Instructions on how to use and sharpen a scraper are found in chapter three, and it will make an easy job of leveling the overhang. A sanding block and sandpaper can also be used, being careful not to make too many scratches on the guitar top.

The top of the guitar should start looking like the above picture, once the binding is brought flush to the face. There should be no glue visible, and no gaps at all. Once the top of the guitar has been scraped or sanded like this, flip it over and do the other side.

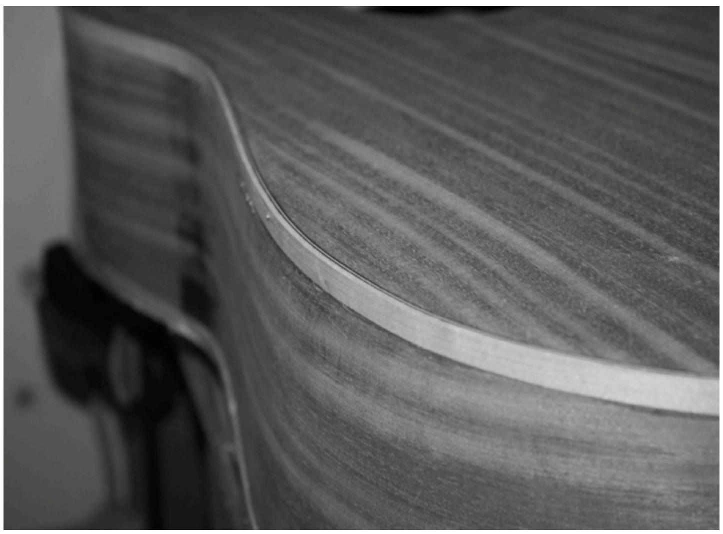
Once the top and the bottom have been made flush, the sides can be addressed. The reason the top was done first was to provide a flat surface for the router to ride against, in order to cut the sides.

It is good practice to sand off any glue squeeze out that is below the binding strips where the bearing on the router may roll over it. Dried

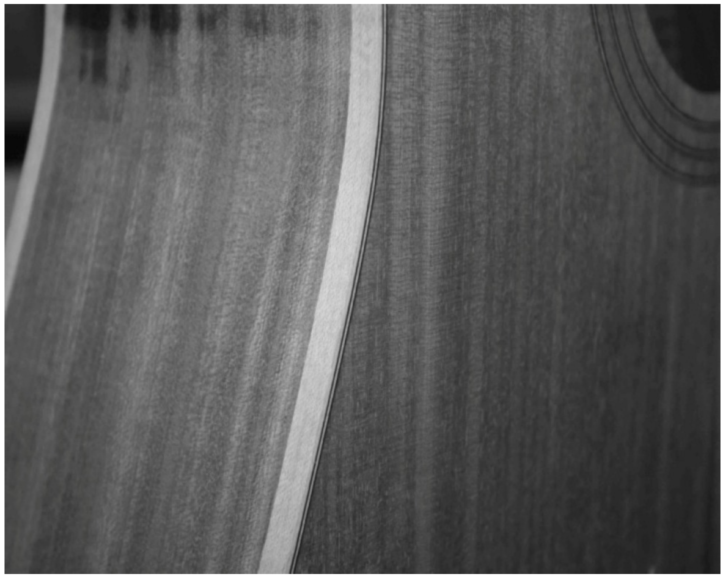
glue will cause bearing to move, and router to cut poorly.

Place a flush trimming bit into the router, which will be one of the bearing sizes in the rabbeting kit. Clamp the guitar down on the bench and trim all the binding overhang on the sides until they are flush, moving the clamps as necessary. Once one side is done, flip it over and do the other side.

The area on the back near the neck will still have to be done with a scraper or sandpaper because of the router plate preventing the bit from getting into this area. It is a quick process however, and will only take a few minutes to clean up.

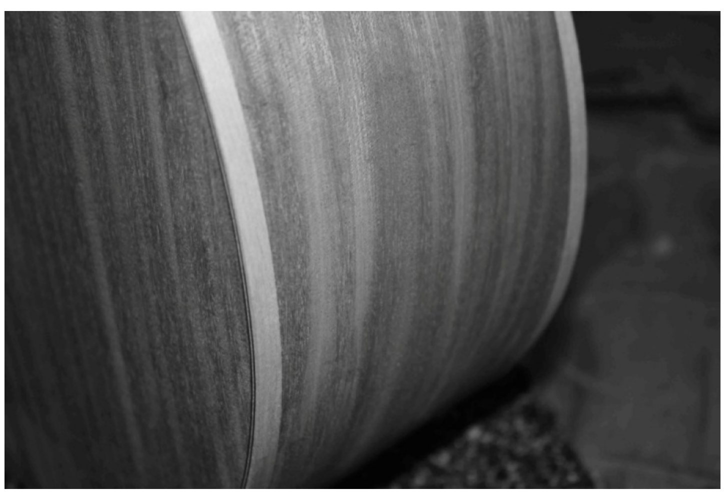


As can be seen in the above and below pictures, the router with the flush trim can only get so close to making the binding exactly flush, there will still be some areas that require a touch up with the scraper or sandpaper.



The router will only be able to get as close to the sides as the bearing will allow. This means that any glue residue or squeeze out that was left on the sides will hit the bearing, and push it away from the side of the guitar. This will make the cut irregular, and cause way too much sanding to need to be done.

Clean the glue around the binding strips before running the flush trim bit. It will make a much nicer cut, and save time scraping and sanding later.



Once the router work has been completed, switch to the scraper or sandpaper and begin refining what is left behind. Work in sections,

getting the binding strips against the sides completely flush, and making long strokes. Longer strokes will blend better than short ones, and they will have less a chance of digging a hole that will be easy to see on the final finish.

Go all around the guitar, scraping everything level and flush, and check the work several times as this process continues. It will take a while to get everything correct, so do not rush.

The process of using a cabinet scraper especially has been used for centuries, and over time, a connection to the wood will be developed by using it. The old masters, ancient lute makers, and classical instrument makers all used scrapers to create their instruments. If it was good enough for them, it is good enough for us.

Project Notes:

The binding and purfling on a guitar is really a great area to showcase woodworking skill as well as exotic wood choices. Almost any piece of wood that can be heat bent (which is all but the most brittle species and most burls) can be used to make beautiful binding.

Most guitars today have very basic binding schemes, and look very basic because of it. If an instrument is being made by hand, it is worth the extra time to install great looking and interesting bindings. Though in many cases customers will want a standard color mixture, on guitars that are being made for personal use it is fun to try something new and different.

Buy a few long and thin pieces of exotic wood and cut them into binding strips following the instructions earlier in the book. Then, try bending them. Something amazing may be discovered.

THE BOUND BRIDGE

Acoustic guitar bridges are often overlooked as potential areas for expression. The bridge is a fairly basic part of the guitar, and silently does its job of holding the strings in place. A simple wrap of binding in the matching color of the body binding, can accent the bridge and give it some well deserved attention.

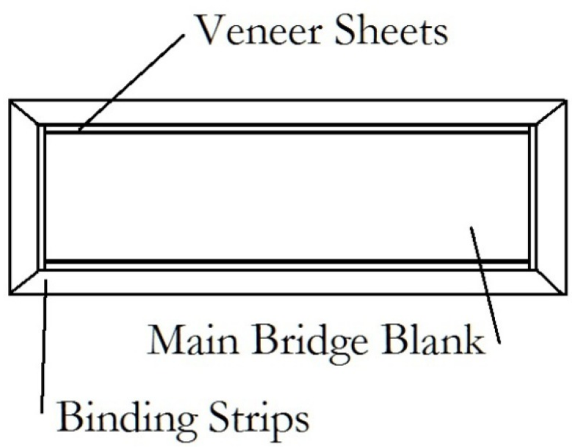
Start with a standard sized bridge blank, usually 6" x 1-1/2" x 3/8" as the main body of the bridge. Smooth and square the edges with a plane or with sandpaper before beginning. The next step is to add some alternate colored veneers to imitate purfling strips. Actual purfling strips cannot be used, because when carving the bridge the depth changes too much, and it would go right through them.

Start with a few sheets of veneer, one being a light color and one being a dark color. The lighter piece here is basic Maple veneer, and the darker one is Walnut veneer. These will be cut into strips to go around the edges of the bridge blank. First glue the lighter colored strip, then the dark. This will maximize contrast between the woods, and in the end draw more attention to the bridge.

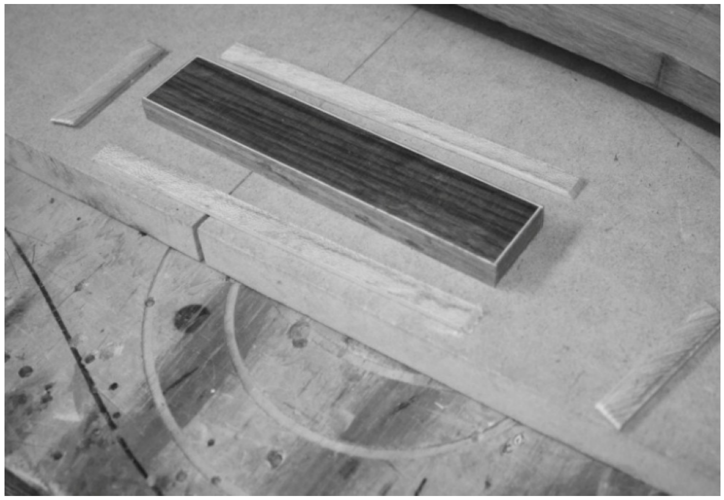
Here is what the bridge looks like after the two layers of veneer have been applied. There are no real rules for applying veneer to the edges to accent the color, other than trying to place light colors next to dark

colors. The outside layer of the veneer needs to be dark in this example because the outside binding will be Maple, to match the body binding.

When gluing the veneer in place, apply it to two opposite ends first, either both of the long sides or both of the short sides. This way once the glue has dried, the veneers can be sanded back even with the main piece. The pieces of veneer that go on the other two sides will overlap the original pieces when trimmed, and since it is so thin nobody can see the joint anyway.



The above diagram shows the detail of the veneer sheets as well as the binding strips on the sides of the bridge blank. The veneer strips are a butt joint, and the binding strips are a mitered joint. The Maple veneer is laid first, then the Walnut in this case. Again, any style of veneer coloring will work for this bridge, as long as the inside color is lighter and the outside color is darker. After the veneer comes the binding strips for the outside.



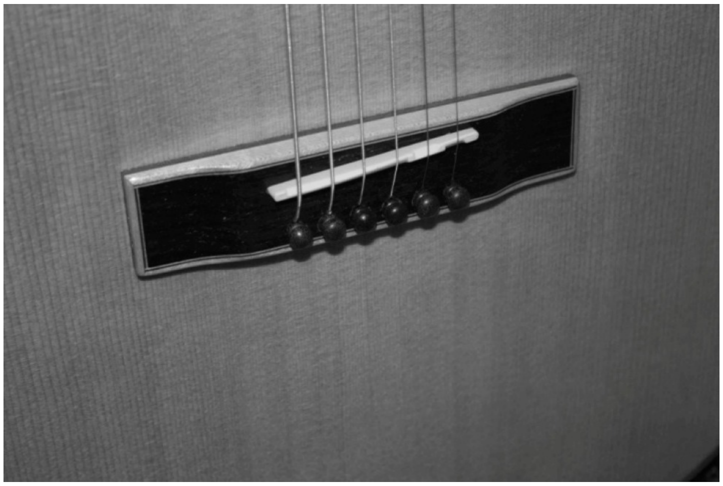
Cut a set of four binding strips that are slightly longer than the sides of the bridge blank they will be going on. Miter one end to a 45 degree angle using a small miter box and a saw. Another way to do this would be to sand the angle using a belt sander or sanding block. Once the one side is done, measure and mark the other side. Cut off the excess and miter it using the same method. Do not go too close to the line on the first try, otherwise it may end up too short, and then in the trash can.

Once each piece is measured, cut, and mitered to 45 degrees, test fit them all together. Check for gaps and make adjustments where necessary.

As in the previous steps with the veneer pieces, glue the binding strips in place opposite sides first. Start with the long ends, getting them lined up and nicely glued into place. After about an hour, the other sides can be glued on. Clean up any glue squeeze out from the ends before attaching the pieces, because they will interfere with having a good looking and clean joint. Attach the sides and allow the blank to dry overnight before moving on to the next part of the project. The reason for this is because the glue will need to be full strength to withstand the forces of carving and shaping.

The bridge can now have the saddle routed, the bridge pin holes drilled, and the rough shaping done. The shaping has to be a little different because of the binding, and the bridge cannot have the curve on the back side like most bridges do. Bevel the wings as a standard bridge, and blend them so they are smooth, and so there are no tool marks.

Finish the carving and move into sandpaper like normal, going through finer and finer grits until the bridge has a surface of at least 320 grit. After that the bridge can be polished with Tripoli compound, or finished with the rest of the guitar.



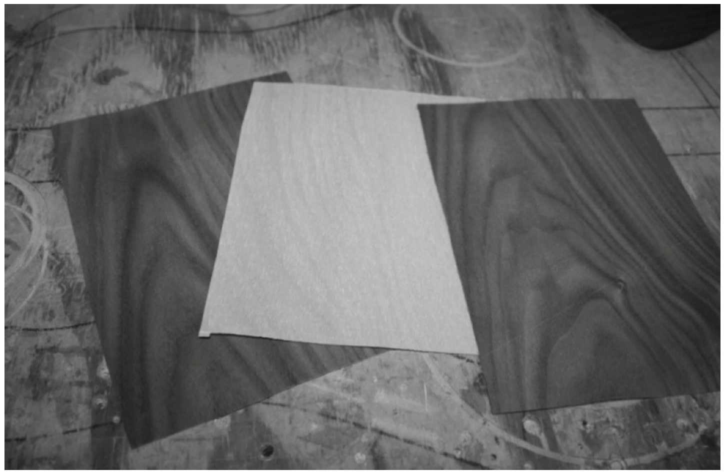
This is the bound bridge, attached to a guitar and strung up for playing. The small accent of the binding and the veneers show up nicely against the soundboard, and frames the bridge very well as the focal point of the guitar top. This is a great project that does require a little time commitment, but the difference it makes can easily be seen.

If binding the bridge seems like something that will be done on many guitars in the future, make up a few blanks at the same time and save them. Because of the large amount of glue drying time, this project can take a while to complete, so it is better to have a few ready to be shaped and glued to the guitar top.

CUSTOM PICK GUARDS

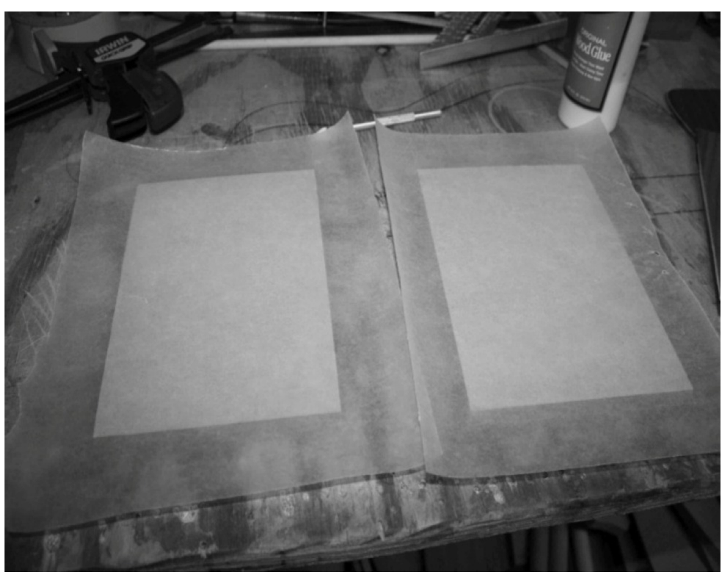
The pick guard on the guitar is really a utility piece that is meant to protect the face of the instrument from being scratched while playing. However, there is no reason it has to be a dull looking piece of plastic. A custom pick guard made from exotic veneers is a very easy project, and it can add a visual bang to the guitar top.

Pick guards come in a variety of sizes and shapes to fit any guitar. This technique will allow copying of an existing shape, or making a custom shape from a template. The above pieces were made from an existing plastic guard on an old guitar. The new Walnut guard will look much nicer than the old black plastic piece.



The guard is cut from a glue up of three pieces of veneer. The only sheet that has to be exceptionally good looking is the top sheet, because the others will be covered. The edges on all three will be visible to a degree, but that can be increased or reduced depending on how much sanding is done in that area.

Start with three pieces of veneer that are big enough to get at least two pick guards out of. Cut them to be the same size, and stack them on top of each other. The way they are stacked is the order in which they will be glued together, so put the best looking sheet on top. It is also a good idea to have the general coloring of the top and bottom sheets the same, with a contrasting middle sheet. This way if the edges are beveled, it will have a nice alternating color look, like a piece of purfling.



The next step is to prepare some clamping cauls and wax paper. The veneer is tricky to glue, and has a tendency to curl and separate. Large flat pieces of plywood or MDF are used on the top and bottom to keep the clamping pressure even, and flatten out the veneer while gluing. The wax paper keeps the glue squeeze out from bonding the veneers to the MDF, and it needs to go on the top and bottom of the veneer sandwich.

This is what the final glue up will look like in the stack from bottom to top. The bottom caul of plywood or MDF, wax paper, the three veneer sheets, wax paper, and the top wooden caul.

When gluing the veneer sheets, it is easiest to use a glue roller of some kind to help spread out the glue quickly. Veneer has a habit of curling up into a tube when wet with glue on one side, and can be hard to work with. Using Titebond glue, apply a thin layer between each sheet and press them together. Lay the veneer sandwich in the clamping setup and clamp it all together firmly.

Use several clamps and a good amount of pressure to hold everything firmly in place. The flat cauls will keep the veneer flat as well, so when it dries it will be rigid.

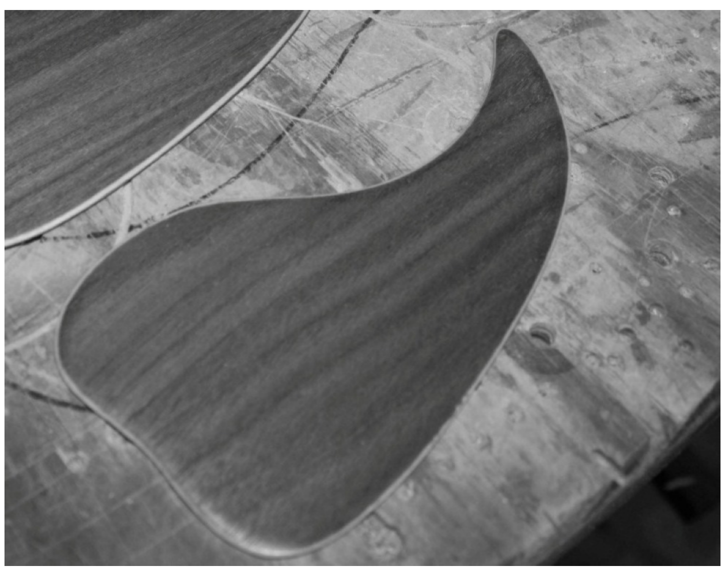
When the veneer has dried overnight, remove it from the mold and inspect the piece. There should be no bulges or gaps in the glue up, and it should be very flat.

Trace the pick guard pattern on the veneer with a pencil, and cut it out with a band saw, scroll saw, or by hand with a coping saw. Sand the edges with 220 grit paper and smooth them out to eliminate any bumps or corners from sawing.

Lightly sand the top with 320 grit paper, making sure not to sand too much, because the veneer is so thin that it can be sanded through very

easily. Do not sand the bottom, as it will not show.

Bevel the edges of the pick guard slightly with 220 grit sandpaper, which will start to reveal the wood pattern on the edges. If this is desirable, sand a nice bevel on the edges to reveal it all the way around the piece. If not, just round the corners slightly with sandpaper to break the sharp edges.



To finish the pick guard, apply a couple coats of Tru-Oil to the top and edges, and leave it to thoroughly dry for several days. Tru-Oil

brings out the coloring of the wood nicely, and is easy to apply, making it a good choice for pick guards.

Attaching the pick guard to the guitar can be done in a few ways. The easiest being by using double stick tape. Use a few small pieces around the perimeter of the guard, plus a couple in the middle area and press it in place on the guitar. It is removable with a butter knife, and should not damage the finish.

They can also be attached with small screws, which are available online or in a specialty hardware store. These screws go through the guard and the top, locking it in place. It will require drilling through the top, which means any future guards will need to have the same hole pattern, otherwise the top will end up looking like Swiss cheese.

TAPERING THE FRETBOARD

After the fretboard has been slotted, and before the radius is created, the board needs to be tapered. The width of the fretboard at the nut is narrower than the width at the soundhole, which allows for the strings to spread out as they travel from the nut to the saddle.

Before tapering the fretboard, it is important to know how wide or narrow to make the taper, and how it will affect the guitar. There are two factors that will need to be considered when tapering, and that is the width at the nut, and the string spread at the saddle.

The nut end of the guitar is where most of the playing will be done, and it needs to be narrow enough to hold easily in the hands, as well as wide enough that the strings can still be played individually. Too narrow of a neck, and chords will be difficult to hold, and too wide would make it hard to grip in the hand.

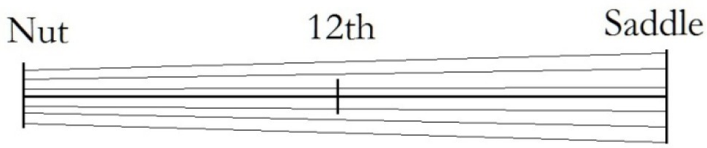
Most guitars will have a nut width somewhere around 1-3/4", and depending on the plans being used, the measurement may be a little larger or a little smaller. For most guitars, 1-11/16" is the standard measurement at the nut, which is perfect for the vast majority of players.

The string spacing at the saddle is the second consideration that needs to be looked at, and most of the time this is around 2-1/8" and up to 2-1/4" depending on the model. The wider the string spacing the easier it will be to finger pick individual strings, but as it gets wider and wider it becomes more difficult to play chords that do not sound separated.

When marking out the fretboard to be trimmed, use the measurement that is included, or use 2-1/8", which is a very common standard. This will keep the strings together somewhat, but still allow finger pickers to play in comfort. This string spread is great for people who use the pick a lot, and makes it easy to move from string to string quickly.

Once the width of the nut and the saddle are known, the next step is to get a width at the 12th fret in order to be able to taper the board. The nut width and the 12th fret width will be drawn on the fretboard, and a line will be drawn connecting them. These lines will be the taper, which will be removed later with the help of a straight edge and a router.

The general rule for setting the taper is to have the 12th fret be the same width or a shade smaller than the width at the saddle. This will guarantee that the strings are not falling off the fretboard near the guitar body. If the 12th fret area were too narrow, the strings may be hanging off of the board on the upper frets. To be safe, use the same measurement as the string spread at the saddle for the neck width at the 12th fret. In this case that would be 2-1/8" wide.



If making a custom taper, it is worth laying out the whole thing in full size to be sure that the strings will be in a playable position once the guitar is constructed. It would be a terrible thing to go through the entire process to find out that the strings are either impossible to reach, or are hanging over the edges of the fretboard.

Use a large sheet of paper, or tape a few pieces of printer paper together that are long enough to draw a full size scale length on. Mark out the location for the nut, and measure the scale length to mark where the saddle will be. Draw a solid line connecting these two points, which will serve as a center line.

Next, draw the actual nut width that is being checked out, as well as the actual saddle width. Split each one between the center line to make this an easier to see process. If the nut is going to be 1-3/4", then make a mark that is 7/8" on each side of the center line, and connect them. The same goes for the saddle, marking it to full scale with the center line splitting it down the middle.

Now that the nut and saddle are drawn in full size and the correct distance apart, mark the locations for the strings at the nut and at the saddle. Measure half the scale length and make a mark on the center line which will represent the 12th fret. Then, connect the lines for the high and low E strings, drawing them from the nut to the saddle to show their placement.

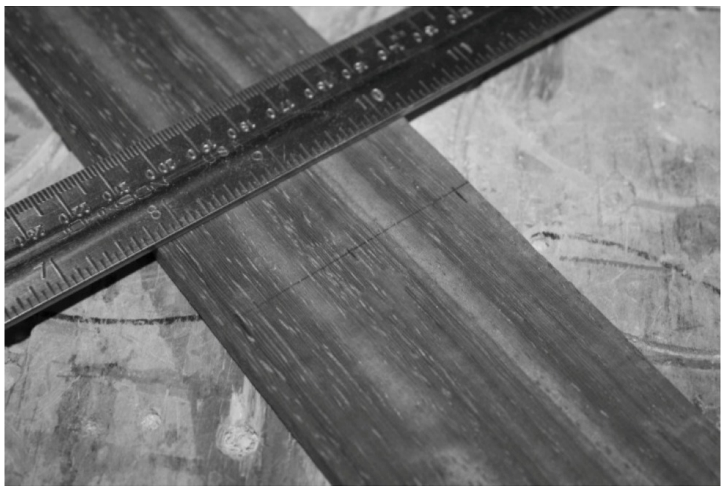
With all of these marks in place, it is easy to see how wide the fretboard needs to be at the 12th fret, because it will need to be wider than the strings that are now drawn in place. Place the width at the 12th fret in full scale, and measure it to see how wide it will need to be. Knowing the width at the nut as well as the width at the 12th fret, the board can now be tapered.

The tapering process takes place on the neck after the fret slots have been cut. This means the board will already be flat, the ends square, and it will be the proper thickness. The board in the picture above does not have the fret slots, however it is the correct size and will be used for the rest of this example.

The reason the frets will need to be cut first is because the fretboard needs to be square in order to use the fret slotting jig that is described in chapter two, and used to make sawing the frets very easy. After it is slotted, it does not matter if the edges are then tapered, because it will not have to go into that jig again.

First, the measurement at the nut side needs to be marked on the board using a ruler. The easiest way to do this is to find the center of the

board and mark it, then use that mark to place the marks for the nut. If the nut is 1-3/4" wide, make a mark that is 7/8" on each side of the center line.

Make the marks dark enough that they can be seen, but do not press so hard that the fretboard is dented, especially at the center. The side marks will be sanded through when the radius is carved onto the board, but the center will hardly be touched.

Next, measure to the 12th fret and make a clear mark at the center of the board. Using the known width of the board in this position, measure half the distance on each side of the mark, and make two more marks. If the width of the fretboard at the 12th fret is going to be 2-1/8", then measure 1-1/16" on each side of the center line and make a mark.

Check the math on these marks a few times before proceeding to the next steps. It is very important to get these placements correct before moving on, since they will directly affect how the guitar will work when assembled.

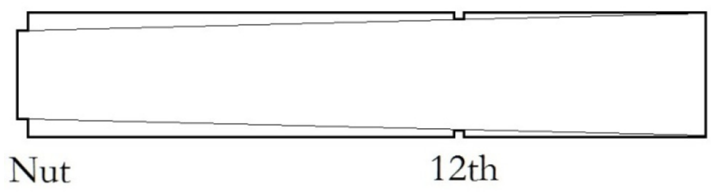
Once satisfied with the measurements, proceed to the next steps where the marks will be refined and the waste wood removed.

Using a long straight edge, like the square in the picture above, connect the marks made at the edges of the nut and 12th fret positions. These lines will serve as a guide that is easier to see than a few small marks, and will help later on while aligning the piece for trimming. A long square or ruler is the best tool for making these marks, as it is known to be straight and even.

Do not press too hard with the pencil at this point, even though the lines are on the edges of the board. They will be sanded through later, however it is good practice to make clear lines that do not dig into the piece of wood.

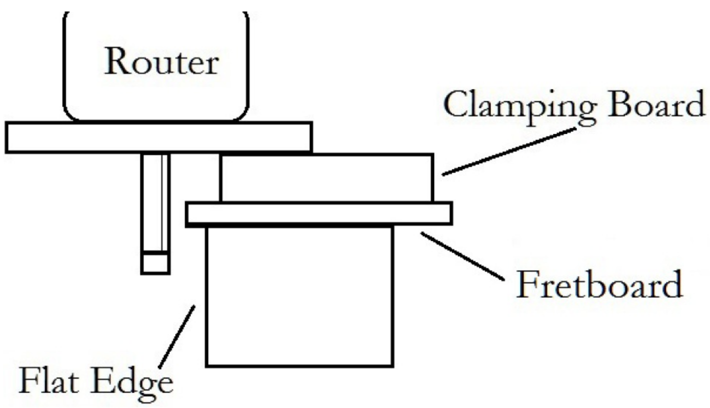
The lines made on this piece are faintly visible in the picture above, and they connect the edge of the nut with the edge of the 12th fret position. Do this on each side, carefully making the line as accurately as possible.

Inspect these lines, making sure they are going through the marks evenly all the way around the fretboard. They should be straight, easy to see, and above all accurate.

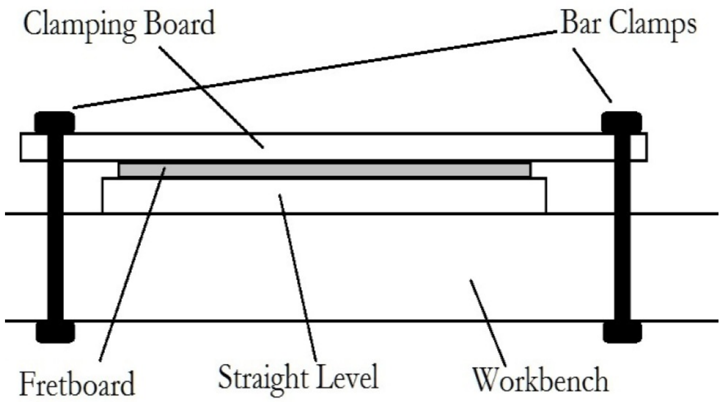


Using a band saw or jig saw, carefully cut four notches in the board, which go up to the lines and only barely scrape them. These will aid in lining up the board for tapering with the router.

At the nut area, be careful to just cut the edge of the board, taking off no more than a blade width from the end. At the 12th fret, go into the board until the blade barely nicks the line, then stop.



In order to cut the taper with a router, a jig like in the diagram above will need to be made. This is very similar to the method used earlier for book matching the plates. A long metal straight edge is clamped to the workbench, which in this case is an old level. On top of it goes the fretboard, and then another longer piece which is used as a clamping fixture, and a place for the router to ride on.



The jig will be set up as seen in the diagram above, and clamped to the workbench. The reason the level is needed, is because a flush trimming bit will be used to trim the fretboard taper, and it will need to have something straight to ride along as it does this. The fretboard is placed on top of the level and positioned where the right amount of wood will be removed, and then the clamping board is placed over it all to hold everything in place. The clamping board needs to be longer than the fretboard and level in order for the bar clamps to be out of the way of the router base.

Begin setting up the clamping jig for the fretboard, and use the small notches that were sawn into the edges as a guide. Line these up even with the straight edge, and position the clamping board on the top as seen in

the picture above. Once the nut end of the fretboard is in position, lightly clamp that side and proceed to the 12th fret area.

Line up the notch in the 12th fret the same way as lining up the nut side. Get the notch even with the edge of the level, and set the other clamp in position to hold it down. It is good practice to take a slightly smaller pass with the router for the first time, since it can be made deeper if needed. If too much wood is removed, the fretboard will have to be tossed, so be careful not to be too aggressive when lining up the board. It is better to make the first cut and still see a little notch left, than to make the first cut too deeply and ruin the fretboard.

Set the flush trimming bit into position and check that the bearing is riding along the side of the level, and the cutters are in position to remove wood from the edge of the fretboard. Once this is correct, the router can be used to trim the overhang.

Position the router at one end of the fretboard and make a couple passes to remove the bulk of the waste. However, do not contact the level with the bearing yet. Once the bulk as been removed, make one pass contacting the bearing the entire time, and not stopping until the entire cut is made. This will guarantee a nice and even cut.

With the first pass completed, the jig will look like the picture above, with the fretboard flush to the edge of the level. Remove the clamps and look at the fretboard, checking to see if the cut was made deeply enough. If more wood needs to be removed, clamp it back in and make another pass. If it looks fine, flip the board around and cut the other side.

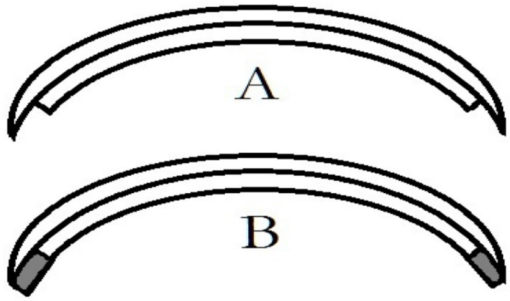
Once both sides have been trimmed, inspect the piece and examine the taper. It should be flush to the drawn lines, and when measured it should come out dead on. It is important to spend the extra few seconds verifying the measurements at this stage, and once they check out, the piece can then be sanded to a radius, and fretted as normal.

BINDING A FRETBOARD

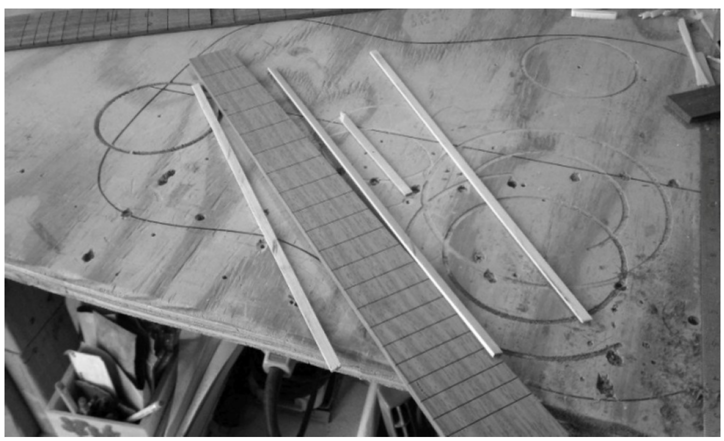
The fretboard on a guitar is a great place to add a little expression without having to worry about whether or not it will work in the long run. An exotic piece of wood with a nice binding around the outside of it looks great on any guitar. It is very easy to bind a fretboard, and since the section on making inexpensive binding strips in the shop was explained in chapter one, hopefully there is a large pile of them just waiting to be used.

The first step is to get a fretboard blank prepared to the point where it can be bound. To do this, take a fretboard blank, saw the slots, trim it to the correct taper, but do not put a radius on it. The taper needs to be smaller at the top and bottom to accommodate the extra width the binding strips will add. The width of the binding strip needs to be measured, multiplied by two, and subtracted from the width at the nut and the width at the 12th fret. When these marks are connected with a ruler, the new and slightly more narrow fretboard can be cut out. After the board has the correct taper and the correct radius, re-saw the slots again so they are all the proper uniform depth.

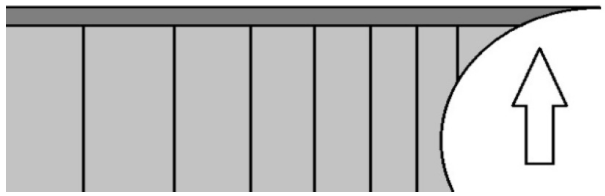
The reason the board has the taper and the slots is because after the binding goes on, no further sawing can be done. The fret tangs are not seen on the edges of a bound neck like they are on an unbound neck. The tangs are undercut a little bit so they do not break the nice clean line of the binding.



The diagram shows the difference between a regular fret B, and a fret with the tang clipped off the two ends so that it does not dig into the binding strip, A. The ends still lay flat on the edge of the fretboard after it is all done, however the edge has a cleaner look than slotting all the way through the binding.

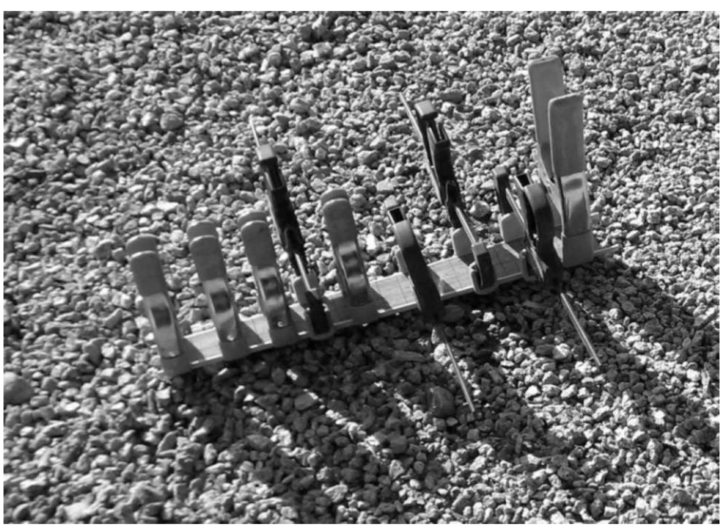


Select the binding strips that will be used for the fretboard, and lay them out to check how they will look. Once a species is decided upon, cut three strips to use. The first two should be the same length, and about an inch longer than the fretboard length. The third should be a couple inches longer than the width of the fretboard at the widest part, at the upper frets.



Lay out the binding strips as seen in the top image in the above diagram, except for the smaller bent piece for the end. The two long pieces will need to be glued to the outside edges of the fretboard with wood glue. Leave about a quarter inch of overhang at the nut end, and the rest at the sound hole end, because it will need to be shaped later on to accept the other piece of binding.

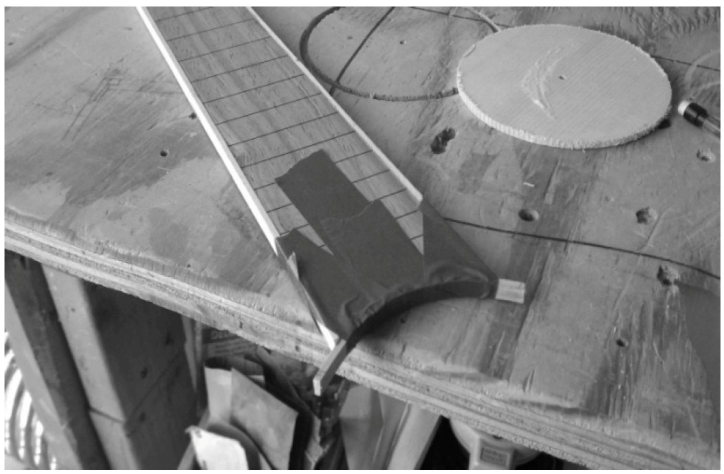
In this example the end of the fretboard is curved to match the soundhole. This is a common practice for acoustic guitars, and therefore it is explained here. A flat fretboard end will not need as much work to finish the bottom end of the binding. A simple 90 degree corner instead of the curved miter will do.



Using as many clamps as needed to hold the binding strips in place, glue them both on the long edges. Before the glue has a chance to

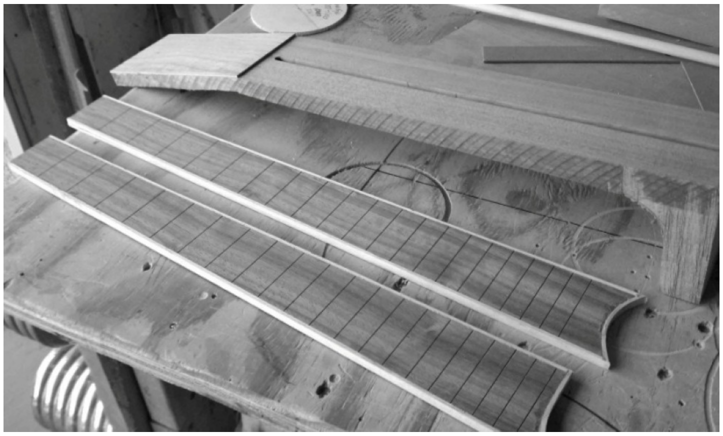
dry, take a tooth pick or other small pointy item and clear any glue from the edges of the fret slots. There is usually a little squeeze out that gets into the slots, and it is hard to get the frets seated properly if there is dried glue in the way. A ton of glue is not needed to attach the binding pieces anyway, and a little less glue will mean a lot less digging with the toothpick later.

Once the glue has dried, remove the clamps and check for gaps or glue problems. If it looks good, use a curved sanding block to shape the soundhole end of the fretboard like in the diagram on the previous page. The curve of the fretboard needs to flow nicely into the binding, since there will be a piece of additional binding in place there.



Once the fretboard is ready for the last piece of binding, heat bend the small strip until it fits nicely against the end of the board. This piece must be bent well enough that it does not take ten tons of force to hold it in place while clamping. The way the piece needs to be clamped, it is hard to get the really good high pressure clamps in place, so the bend needs to be good.

The best way to secure it to the fretboard end after it has been bent and the glue applied, is to use masking tape. In the picture it happens to be the blue painters tape, but the regular inexpensive tape works fine too. The blue tape is a lower tack version of the regular tape, so the basic stuff holds a little better too.



Once the smaller strip has dried, all the overhangs can be trimmed back, and sanded to a smooth look. The binding strips will be taller than the edges of the fretboard, and they too will need to be trimmed flush. Trimming them with a chisel or a plane will work, but go slowly since it is easy to get a big chunk on accident. After the bulk is removed, switch to a radius sanding block to trim it even and radius the fretboard. A scraper can do this work too, just be careful not to remove too much material before switching to the radius sanding block. The slots need to be full depth to take the frets later on.

Cut all the frets to length for each slot, and trim them like the diagram on the opposite page. An end nipper that has had the faces ground down (instructions in chapter two) or a wire cutter makes easy work of

removing the small sections of fret tang. The fretting goes on as normal from this point.

FRETTING OFF THE NECK

In most guitar making methods, the fretboard is fretted and finished while the neck is attached to the body. This is much more difficult than fretting the neck first for several reasons.

First, installing the frets that are over the body of the guitar is much more involved, because this area cannot be hammered against very well. Even with a support under the top to help with the hammer blows, it is harder than it should be to put in these frets.

Second, the ends of the frets will need to be filed and dressed, and this can lead to gouged tops and damaged fretboard edges. With the fretboard already glued in place, it is very hard to get into the tight spots near the top and file away the fret overhang.

With the fretboard alone, it is possible to lay the entire long edge down on a flat surface and work it against a large piece of sandpaper. Likewise, it can be clamped into a vise and a large sanding stick can be used to get a nice and straight edge.

Lastly, with the fretboard being small and mobile, doing inlay work is also easier. A bulky neck is hard to get into a drill press, but a thin piece of fretboard goes in very easily. The piece can also be brought in from the shop and worked on, rather than having to move around the entire guitar.

Begin with a fretboard that has been slotted, radius sanded, and tapered. The important part of this method is to have the fretboard the exact dimensions it needs to be for fitting on the neck, because the neck will be carved to match the fretboard. Any inlays should also be done at this point, as well as any other decorations like side dots or binding. The neck at this point is ready for fretting, which can be done differently with the fretboard off the body.

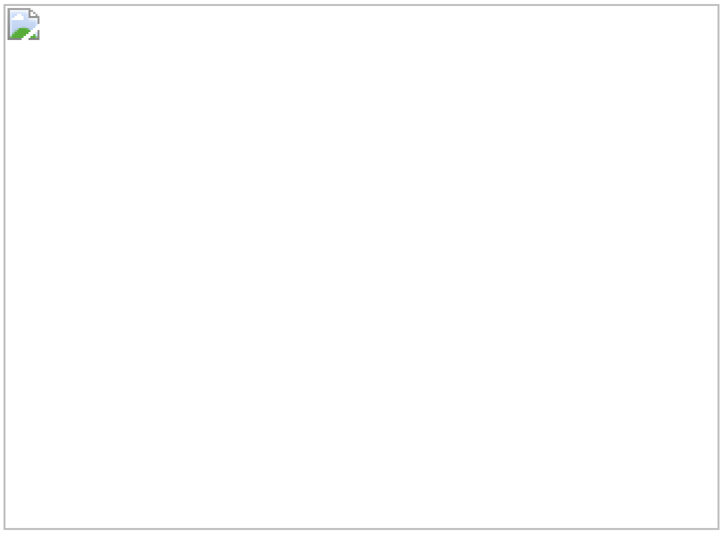
Run the fret wire through a fret bending jig, which there are instructions for in chapter two, and put an even bend into the wire.

Measure and cut the fret wire so that it overhangs the edges of the board by about 1/4" or a little less on each side of the fret slot. Work from the nut area to the upper frets, keeping the frets in order as they are cut. The frets get wider as they go up the board, so if they get out of order, some of them might end up not fitting.

Using the fret setting caul described in the tools section of this book, the frets can be set all the way along the board. Do this with the board on the shop floor or on a very sturdy bench that can handle the force of the hammer. The least amount of hammering it takes to seat the fret the better, which means a hard surface to hammer against is important.

Start at the nut end and begin installing the frets. Start by tapping each end of the wire into the slot with the hammer. Then, follow with the fret setting caul and drive the wire into the slot fully. Move down the fretboard until all the frets have been installed this way, making sure to leave a little overhang on each side.

The fretboard should now start looking like the above picture, with each wire being hammered into place. Check each fret as it goes in to make sure it is seated completely, and re-set those that are not driven in all the way.



The huge advantage to finishing the fret board off the neck is in filing and chamfering the ends of the frets. Before, all this had to be done while it was on the neck or the body, which made getting into the tight spots very tricky. This also made the possibility of damaging another part of the guitar while filing much more real.

With the fretboard separated from the neck, the ends of the frets can now be clipped with the fret cutting pliers, cutting them close to the fretboard.

Be careful to clip them evenly because the tool can mash the wire, causing it to twist and ruin the fret. The goal with the pliers is to remove a little excess waste, so the file or sander does not have to work as hard.

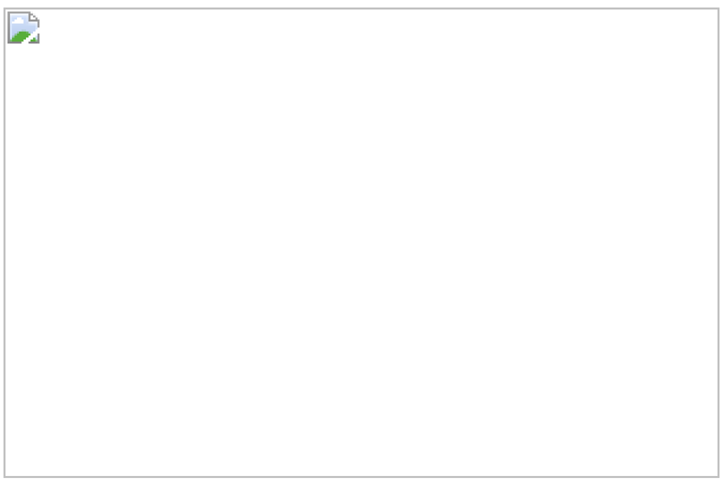
Take the fretboard and begin filing the ends down until they are even with the board. This is where a belt sander comes in handy, because it makes very short work of making the fret ends even with the board. It can also be used to chamfer the ends of the frets, by holding the fretboard at a little bit of an angle while the belt removes material.

This takes a little getting used to at first, because a belt sander will remove a lot of material quickly, but it also really does a nice job. The

only thing to remember is to make sure the direction of the sanding belt is always dragging the frets down and into the board. If the board were flipped upside down, it could rip out the frets from the force of the belt.

Once the ends are all even with the board, tip the fretboard up to around 30 degrees and bevel the edges with the belt sander as well. Once the power work is done, dress the ends as normal with the fretboard still off the neck. This will round over the sharp edges of the fret wire caused by sanding.

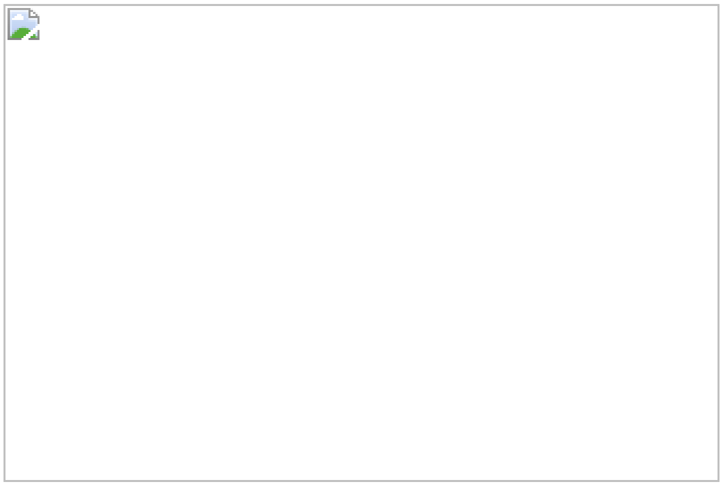
Any additional work that needs to be done to the board should now be done as well, because it will be glued to the neck blank in the next few steps. The final leveling and polishing of the frets must still wait until after everything is together, because the addition of the neck wood can change the flatness of the fretboard. If all the leveling were done now, and the board were to move a little once attached to the neck, the whole job would have to be done again.



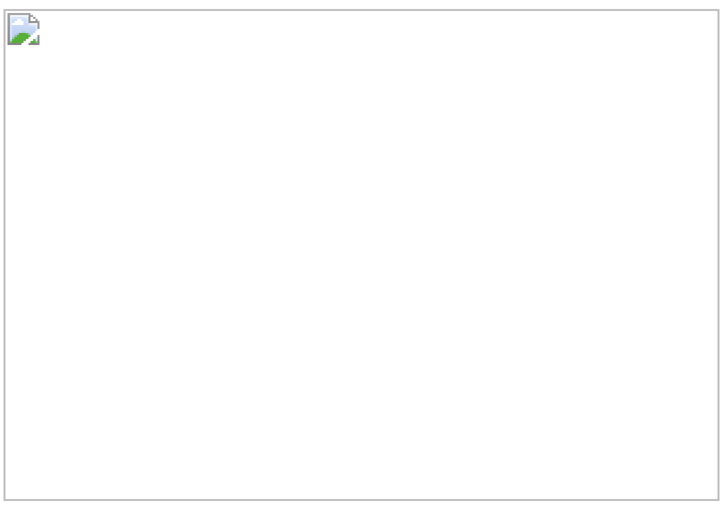
To glue the fretboard to the neck blank, start by measuring and marking the width of the fretboard at the 14th fret (or the fret that will contact the body depending on the plan) and center the fretboard over it. Once satisfied with the location and the centering, hammer two small tacks on each side of the board, so they are touching it.

The purpose of the tacks is to hold the end of the fretboard in place while gluing, and not let it slide from side to side. The holes made by the tacks will not be seen on the final instrument, because the excess wood on the sides of the neck blank will be sawn off after gluing. To remove the

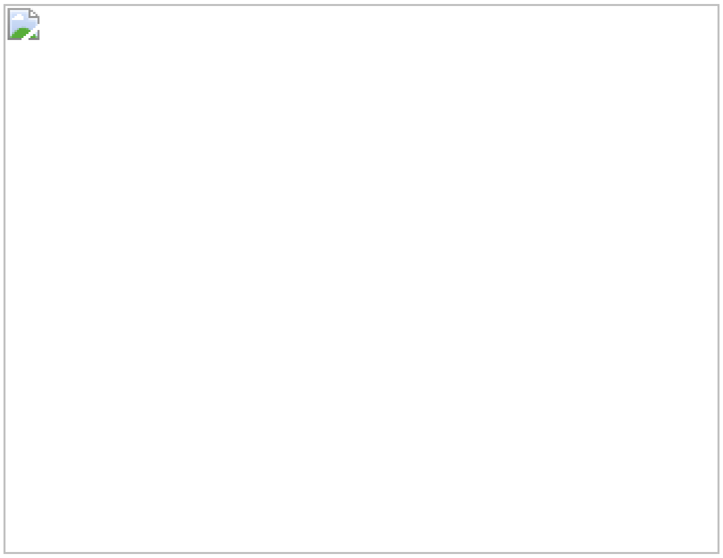
fretboard from the tacks, slide it towards the right if looking at it as in the picture above.



The nut side is treated the same way as the body join area was, and two tacks are driven in to keep the fretboard centered. Measure carefully again to make sure the board is straight, and the tacks should be touching the sides of the fretboard to keep it from moving.

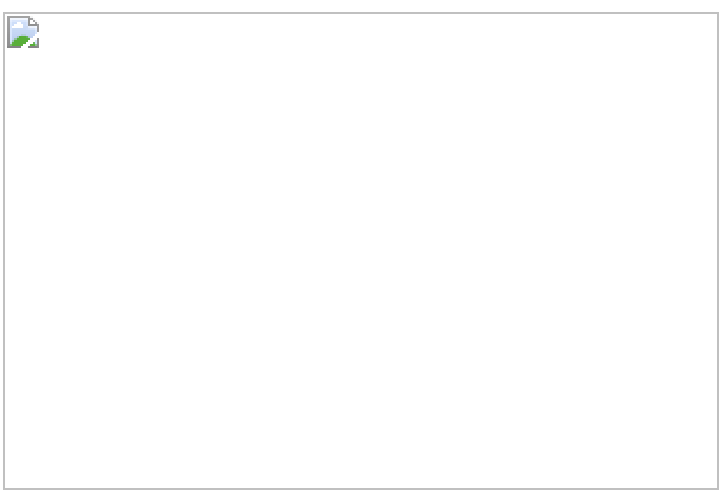


Slide out the fretboard from under the tacks, and apply Titebond to both the underside of the fretboard and the top of the neck.

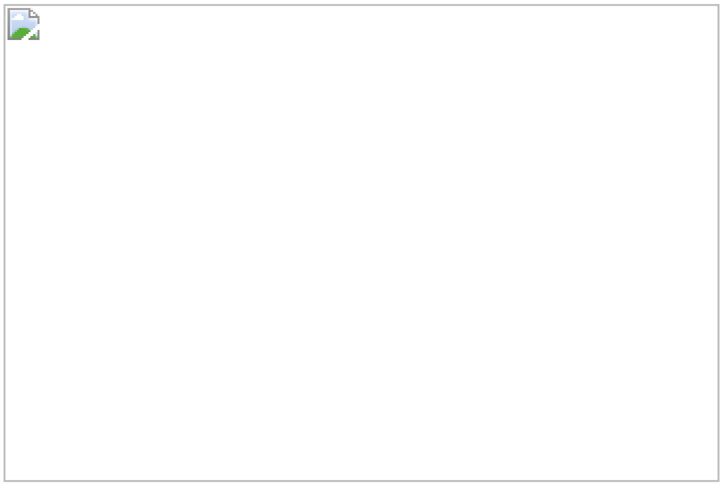


Add clamps carefully, and do not clamp them to full pressure until they are all in place. Begin on each end, adding a clamp at the body side then one at the nut side. Continue to alternate in this manner until all the clamps have been positioned and they are all of light to medium tension.

Begin with the clamps in the center and start tightening them from the center out. Move in the same manner as before, doing one clamp on the nut side and one on the body side. This time however, start from the center instead of the ends. Working the clamps like this will help prevent any bulge in the middle of the board, though that is still fairly hard to do by mistake.



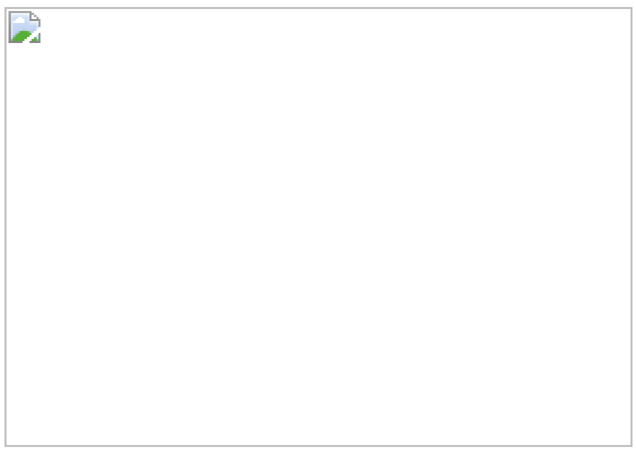
When the glue is dry, inspect the joint for gaps, making sure everything was glued well. The next step is to cut off the excess wood on the sides of the neck with a band saw or hand saw.



Once the bulk has been removed, the edges can be scraped, planed, or sanded until they are level with the fretboard. Since the fretboard is the correct size, it is important not to remove any wood from it, rather bring the neck wood to the same size as the fretboard. Final shaping can now continue as normal.

STACKED HEEL CAP

One of the simplest adornments for an acoustic guitar is the cap which is placed on the heel of the neck. This small piece of flash serves to cover up the butt end of the neck, as well as provide a point of contrast where the two pieces attach. Most often, heel caps are made with a single piece of contrasting wood, however when several pieces of wood are used, it makes for a more interesting heel.

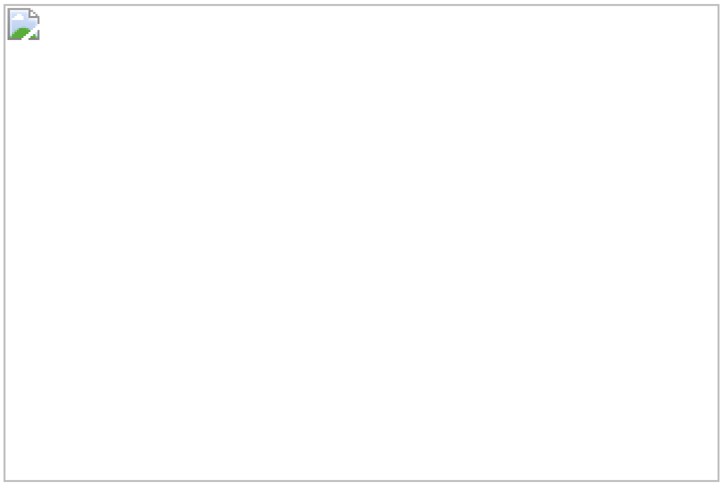


The easiest way to make a more interesting heel cap is to laminate a series of three species of wood, where the top and bottom layers are the same species. The middle later will be a contrasting layer, and the outside layers will contrast the neck color as well. If the neck is light in color, create a heel cap that is dark on the outsides and light on the inside.

Once the three pieces have been glued together, trim one edge flat and lay the glue up on top of the heel. Take a final measurement to ensure that the total length is not any longer than the shoulder area of the guitar, which would make the heel of the neck too long. Make sure the flat side of the wood sandwich lines up well with the part of the heel that will be glued to the guitar, as this will need to be perfectly flat after gluing.

Clamp and glue the alternating wood pieces as one unit to the end of the heel, lining up the gluing area of the neck well before clamping them down. If the flat edges are lined up well enough, next to zero sanding will be needed in the heel area where the neck will join the guitar body.

After the glue has had time to dry, sand the rough edges of the heel cap to blend them into the rest of the heel. Try not to sand the flat area where the joint will be made later to the body, as this will ruin the flatness. When the area is smooth and the transition between the heel and heel cap are flawless, the sanding is complete.



Heel caps are easy places to express a little creativity without taking too much of a chance. A few well placed silvers of wood that contrast well and add some flash to an otherwise boring part of the guitar are always well received by those playing a custom acoustic guitar.

MAKING A FRETLESS NECK

Fretless necks are typically made for acoustic and electric bass guitars, and they open up a few things for the experienced player. A fretted neck only makes one sound when the string is played and a fret is held, and then another sound if another fret is pressed. A fretless neck allows the musician to make subtle changes to the pitch of the notes, in order to keep them in tune with everyone else. They are not restricted into boxes like with a fretted neck, and can produce an infinite number of tones.

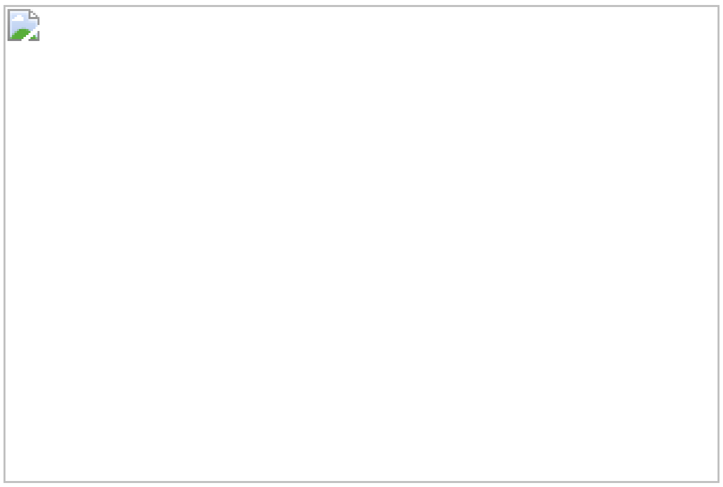
The problem with a fretless neck however, is that not everyone has the ear to be able to play it well in the beginning. Fretted necks offer a crutch because as long as the right fret box is pressed, the right note will emerge. With a fretless instrument, the finger placement has to be deadly accurate, otherwise the wrong note will sound.

A compromise to this is having a fretless neck that still has markings for the fret locations. This is done on an existing neck by removing the frets with a very thin fret pulling pliers, and gluing thin pieces of veneer into the slots. It can also be done on a new build in the same way, except the frets do not need to be removed first.

The only difference in the process between a new build and a re-fret, is the removal of the old frets on an already built bass. There are a

number of tools sold for this, and the best is a pair of fret pulling pliers that are specially made for the job. They will reduce the amount of splintering in the wood and also the amount of sanding in the end.

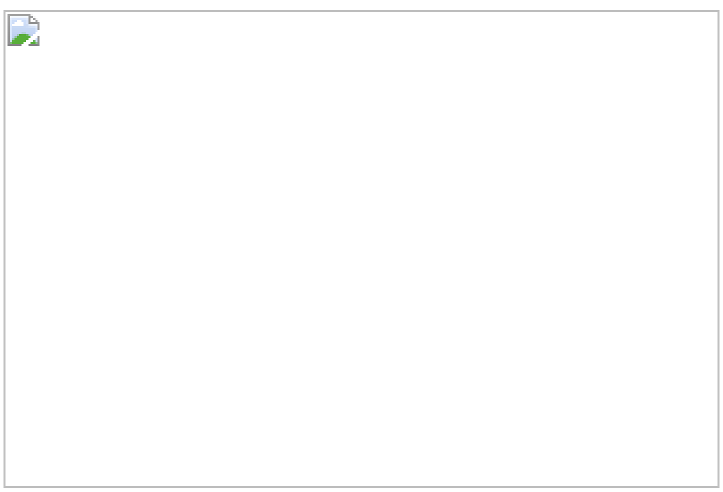
The process here will be the same from the point that the frets have been removed. The fretboard in the above picture has been slotted and the radius has been put on. At this point it is ready for some veneer strips that will show the location of the fret, but not actually be a three dimensional piece of wire.



Thin pieces of veneer are used to show the location of the fret by contrasting the color of the fretboard. If a dark fretboard like Rosewood is being done, use a light colored veneer like Maple. If a light colored fretboard is being done, switch to a darker color of veneer like Walnut. The idea is to make contrast between the main color and the new fret color. Cut the veneer into strips that are 1/4" tall and 3" wide, which is plenty to work with for each slot.

Standard size veneer is still a shade too thick to be able to get into the fret slots once the glue has been applied, because this causes the wood to swell a little bit. The edge of the veneer can be sanded back to an angle very quickly on a piece of 100 grit sandpaper, so it has a sharper edge to enter the slot with. Do this to all the veneer slices that are going to be glued into slots.

Also, the fret slot needs to have a flat bottom, because the veneer piece being glued in is also flat, and does not bend well. The upper diagram shows a cross section of the fret slot, and how on a normal fretboard it is curved to match the radius of the board. The lower diagram shows how the flattened slot needs to be deeper at the center so it can be flat all the way across. This is done with the fret saw and depth stop, only sawing until the depth stop hits the highest point of the fretboard. With the fret saw held completely level, saw until the hump in the middle of each fret is removed, leaving a nice flat bottom. Do this for all the fret positions.



Once all the slots have been sawn flat, next comes the glue. Titebond original will work well for this task, since it is wood on wood. Drizzle a small line of glue into the slot, trying not to get it everywhere else in the process. Do this one fret slot at a time because there always seems to be one slot that puts up a fight in order to get the veneer in place. If glue

dries in another slot while fighting with the first one, it will be a pain to remove.

Pull the veneer pieces into the slots by their ends instead of pushing them into place. Pushing will just break the veneer, but pulling works better at bringing the whole piece into the slot. There will be glue squeeze out, but do not worry too much about it, because the whole board will need to be sanded in the end anyway. The edge of the veneer strip can be used to shuttle glue into the slot also as it is inserted, which will help get any excess glue into the slot.

Repeat this procedure for every fret slot, working one at a time until they all have a strip of veneer glued in place. Do not worry about clamping anything to hold them down, because again the veneer will just crack and fall apart under the stress. Inspect the ends of the fretboard and the slots themselves to make sure that all the veneer pieces are still in them, and that nothing popped out. Leave the piece to dry for several hours, or better overnight.

After the piece has had time to dry, sand back the veneer until it is flush with the fingerboard. Start by carefully breaking off the excess veneer that is sticking out over the top of the fingerboard. This must be done slowly, so that it is not broken below the surface of the fretboard. Once the bulk has been removed, use a sanding block with 220 grit sandpaper to bring everything level.

Any glue squeeze out can be handled with a scraper blade if it is really bad, or just by sanding. The important thing to remember is to keep the sanding even and along the entire length of the board. Bumps and humps on this fingerboard will now be felt by the player, so work to maintain a flat surface.

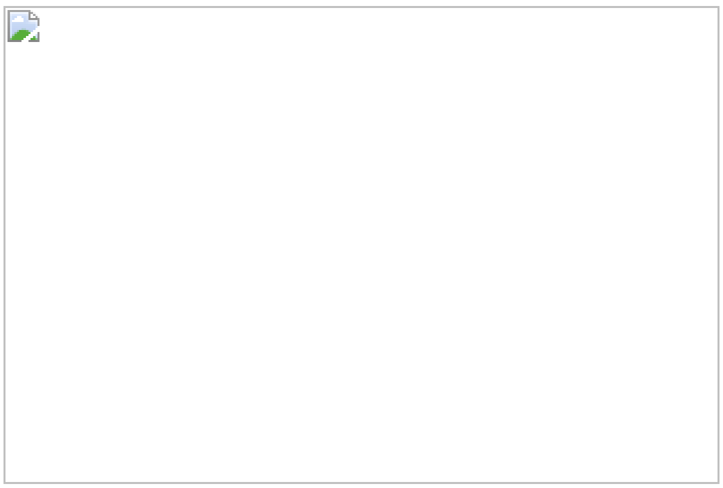
After the board has been sanded, it is ready for the next assembly step for the instrument. A new build will be ready to be tapered and attached to a fretboard. An existing neck that was re-fretted to a fretless neck will be ready to be bolted back on and played.

Minor adjustments to the nut and the saddle will need to be made to deal with the fact that the action of the bass is now much higher than it was when the frets were there. Each will have to be lowered a little bit until a comfortable playing height is reached.

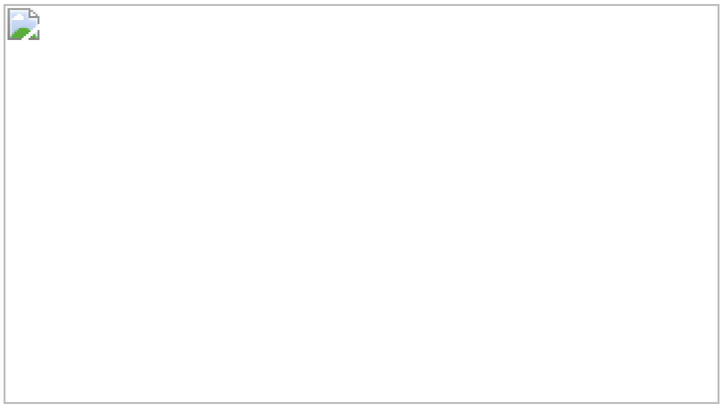
Now the freedom of a fretless instrument is available without the fear of not knowing where to play to get a certain note. This is a great compromise, and offers all of the positive with none of the negative.

TRUSS ROD MAKING

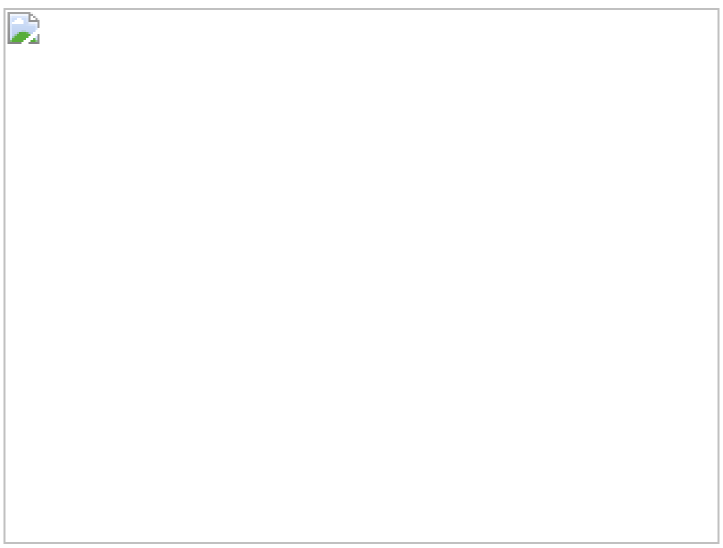
The standard dual action truss rod is easy to make in the shop, and can definitely save more than a few dollars over buying pre-made truss rods from the supply houses. The truss rod is the metal piece that resides under the fretboard, which can be tightened to correct forward bow in the neck. This is caused by the strings pulling the neck forward, which the truss rod moves backwards again, bringing the strings closer to the fretboard.



The supplies needed to make truss rods can all be found in any home improvement store or hardware store. They are a 3/16" mild steel rod 36" long, a 10-24 or 10-32 die and die wrench, a piece of thicker steel for making a bearing nut, and a long nut which is used to connect threaded rods. Make sure the nut is the same thread size as the die, because it will need to screw onto the rod once it has been threaded.



Measure to the middle of the rod, which will most likely be 18", and file a small notch into the rod on one side. The notch needs to be even on both faces, and must only go through the rod about 1/3 of the way. Any further will weaken the structure. Clamp the rod to the workbench to keep it from moving.



The notch should look like the picture above when it is completed. The clamp holding the rod to the workbench makes it easier to get the notch centered, because it is difficult to hold down the small piece by hand.

Use a square file to make this notch, because it will be the easiest to keep straight. If a square file is not available, a rectangular file

can be used on a corner, just make sure the sides stay even and the notch goes straight into the rod.

In order to bend the rod without weakening the pivot point or breaking the rod completely, the portion to be bent must be heated first. A propane torch is the perfect item to heat with, and should be available in the shop anyway if a hot pipe is used for bending wood.

Light the torch and set the regulator to a medium flame. Position the notch over the flame and rotate it for several minutes. There will be two visible cones of flame coming out of the torch, one inside the other. The inner and lighter blue cone is the hottest part of the flame, and placing the center of the rod right over the tip of the inner blue cone will heat the piece the fastest.

Rotate the rod as it slowly heats up, making sure to keep the fingers and hands several inches away from the center of the rod. If the rod starts to get warm on the fingers, move them farther from the center and continue rotating the rod slowly.

The rod will change colors right around the flame, and after several minutes will begin to glow bright red and then orange. Once color can be seen about 1/4" on each side of the notch, the rod is ready to bend.

There are several ways to bend the legs of the rod in half once the center has been heated enough, and any of them will work. It can be done in a vise, with a hammer, or by pulling the two ends around a nail and then hammering.

Most woodworkers will have a small metal vise that can be used to clamp down the two ends once they are ready. The only down side to this method is that it can take a little long to get the rod compressed as tight as it needs to be. To help speed up the process, leave the vise open only a little wider than the size of the rod when doubled over, and make sure the area

the vise is in is clear and ready to be used. In this way the process will not have to wait until the area is cleaned, in which time the rod will have cooled.

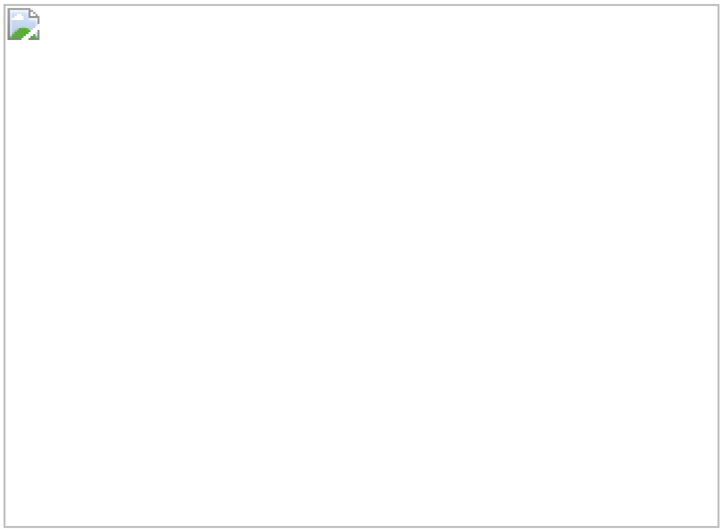
As seen in the last picture in the previous column, the rod has not been collapsed as far as it could be, which means the piece cooled too fast, and will need to be hammered into final position.

Using a hammer and a flat metal area such as a table top or even a concrete floor, hammer the end of the rod until the two pieces are totally flat against each other, and there is no gap. This must all be done very quickly to ensure the steel remains strong, and do not hammer the end for no reason once it has folded flat. Be sure to heat the end of the rod again before it is hammered, and work quickly.

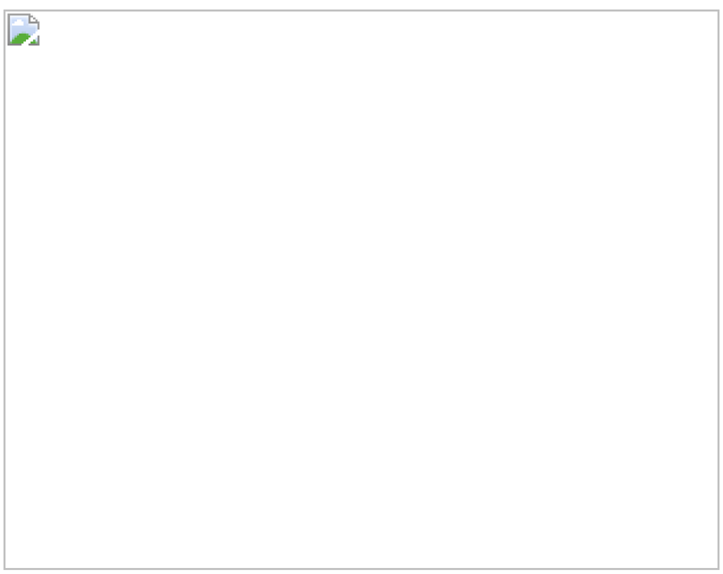
Before the threads can be put on the rod, it will need to be cut to length. This will vary a little bit depending on the size of guitar being made, and the number of frets to the body.

Most truss rods will end up being around 15" long from end to end, a little longer if they are going to be adjusted at the upper face brace and a little shorter if adjusted at the head block.

For a Martin standard scale length that will join at the 14th fret and be adjusted at the headlock, measure 14" long on one rod and make a cut there, and then 14-3/4" long on the other, and make the second cut. The one leg of the rod will need to be a little longer in order to have extra threads inside the adjustment nut at all times. This way there is always enough strength to exert tension on the rod. A nut that only takes in a few threads before adjustment can bend and rip the threads under the tension required to tighten the rod.

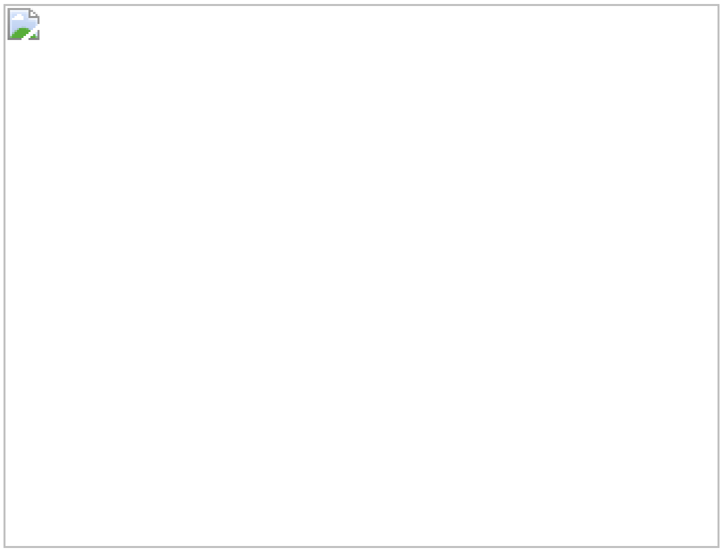


Clamp the ends of the rod into a vise, and separate them a little bit before clamping the jaws closed hard. The longer of the two will be the leg that is threaded, and it will need to be in the area of the clamp that exerts the most force.



A die and a die wrench are needed to create the threads on the rod, and can be found in any hardware store. These sometimes come in sets, however only one die size will really ever be needed, so only purchase the size that matches the nut. The little die itself should sit inside the wrench,

and be held in place with the knurled screw at the top. If the die becomes loose, replace it and tighten the screw again.



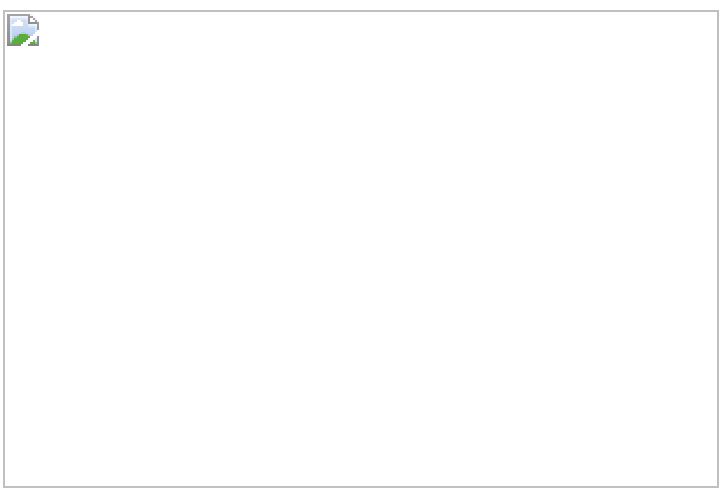
Start by placing the die and wrench on top of the longer rod, with the larger opening of the die facing down. Keep the die wrench perpendicular to the rod and at a 90 degree angle. This way the threads will be cut straight, and not overlap at all.

Begin turning the wrench clockwise slowly, and as a couple turns are made, the teeth on the die will begin to cut into the rod. Keep turning the die, making sure it stays straight and even as more and more threads are cut into the rod.

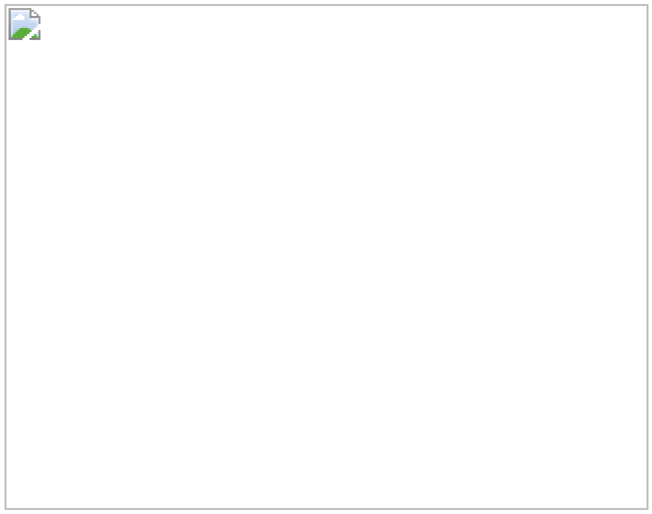
After each full turn, it is a good practice to turn the die in the opposite direction about a quarter to half a turn, which allows the metal shavings to come loose and fall to the floor. Keeping these shavings out of the way will make the die cut easier and last longer. Since this is mild steel being cut, there is not a need for any liquid lubrication, though it can be used if desired.

Continue to cut threads until the die has made it past the end of the other rod by about half an inch, and then begin to back out the die slowly. Twist it back and forth a little bit to allow the metal shavings to fall out, then begin turning the die counterclockwise until it comes completely off of the rod. The end should look like the picture above, and have about 1-1/4" of threads on it.

Inspect the threads to make sure they are cut cleanly and that there are no gaps or gouges in the rod where the die may have broken. If the threads look fine, the end piece can now be made.



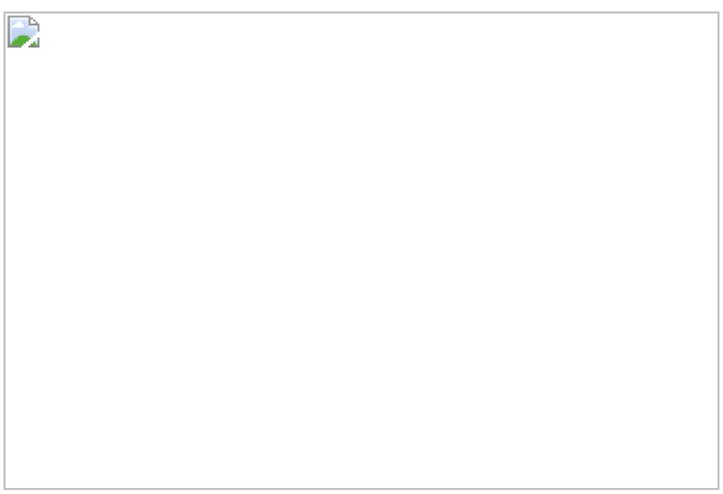
Find a piece of steel that is around 1/4" thick and at least an inch wide. Strips like this are usually sold near the threaded rods in the hardware store, or really any piece of metal that can be cut with a hack saw will do.



Cut a piece of steel that is 3/4" wide, about an inch tall, and 1/4" thick. The bars found in the hardware store should be around 1/4" thick, and are plenty strong to make a bearing nut from.

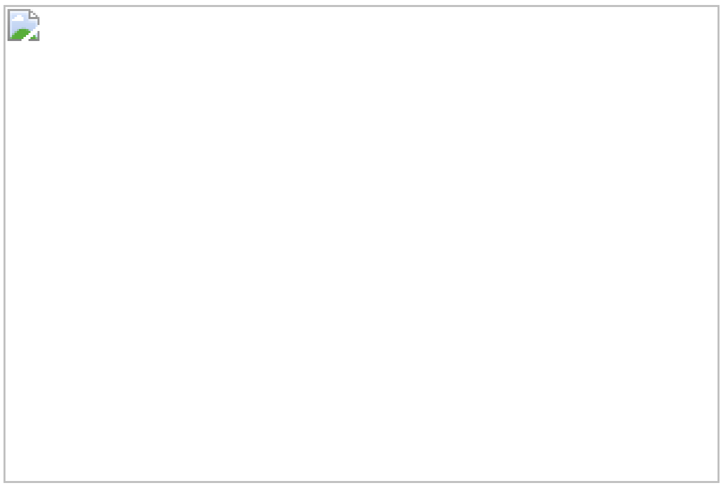
Once this piece has been cut, there are a couple drill holes that will need to be made, in order for the truss rod to function properly.

The diagram above shows the locations and measurements for all of the holes, and where they are positioned on the piece. The top drill hole is not actually a hole, as can be seen by the side view to the left side of the diagram. This hole will need to go about 3/4 of the way through the piece, stopping before it goes completely through. This drill location is meant to stop one end of the rod, and not allow it to advance any farther through the metal piece. Take care when drilling these holes, so that they are lined up well vertically.



It is best to drill these holes with a drill press, however a hand drill will work as well. Make a small indent with a hammer and nail where the drill hole center will be, this way the drill bit has something to follow, and will wander less before finally biting into the metal.

Run the drill press a little slower if possible, which will reduce the heat buildup in the bit as well as in the metal piece. Back out the drill bit often to remove metal debris, and to keep the hole from clogging up. Use a clamp to hold the piece steady if it cannot be done safely with the fingers.



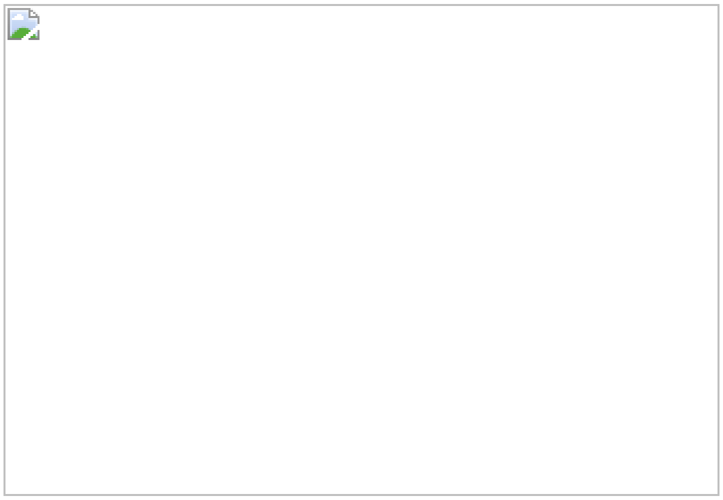
The image above shows the piece once it has been drilled, and the closer the two holes can be the easier it will be to install the truss rod later. The diagrams say the holes are to be 1/16" apart, and this should be a maximum distance. If the holes are closer to 1/32" or so, that will be fine as well.

Again, the first hole does not go all the way through the piece of metal, it stops about half way into the piece. The second hole, the larger hole, does go all the way through.

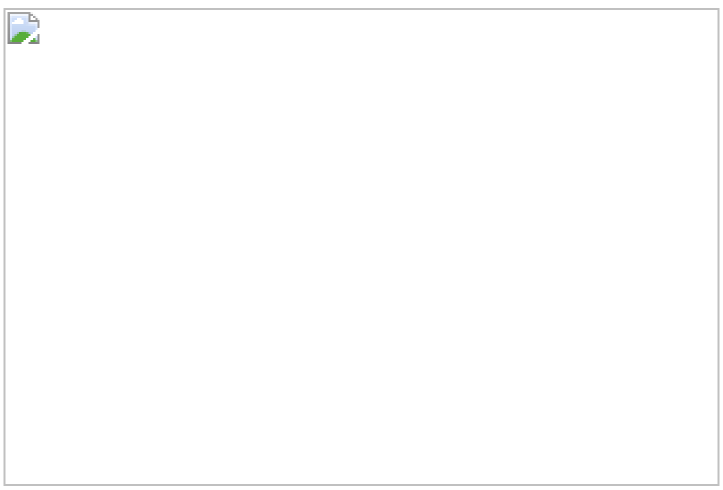
Slip the bearing nut over the end of the rod, with the threaded end going through the hole and the other end inside the partially drilled hole. If the non-threaded end does not want to go into the hole very easily, chamfer the ends on the belt sander slightly, which will allow for an easier fit.

Check that there are some threads sticking out past the metal piece, as can be seen to the left of the bearing nut in the picture above. These extra threads will be needed when adjusting the rod.

From behind, the rod will look like this, with the bearing nut attached. The upper leg sticking into the partial hole, and the lower going completely through.



Screw the nut onto the threaded end of the rod, tightening it until the bearing piece is flat against the upper rod, and no further. This is how it will be installed in the guitar neck, and when the nut is turned, the rod will press backwards with a large amount of force, correcting any issues in the neck.



Lay the truss rod on the bench and inspect it for any flaws. It should be straight, the legs should not be twisted at all, and it should feel strong when flexed. The nut should have no trouble threading onto the rod, and the bent end should be free from cracks or other structural issues.

Project Notes:

Sometimes it is easier to measure the length of the truss rod by using the exact neck that it will be going into as a guide. The neck must be completely ready, including any modifications to be done to the heel like a mortise and tenon, as well as have the slot already milled.

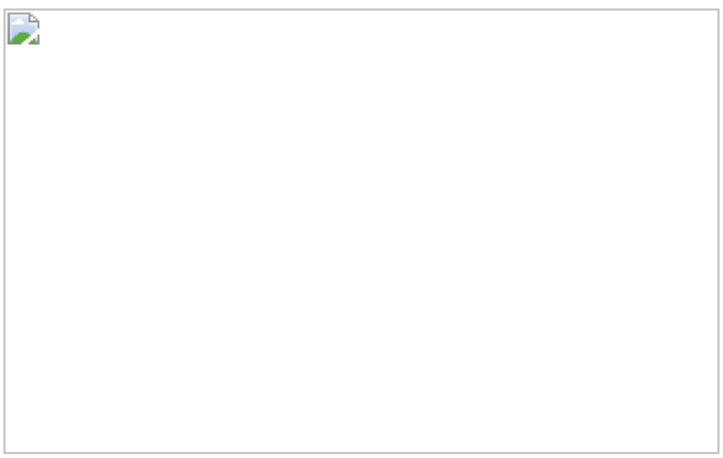
Insert the rod all the way into the slot, and make a mark that is 3/4" from the heel on one leg of the truss rod, and 1-3/4" from the end on the other leg. Remove the rod and cut the ends off at these measurements.

This type of measuring assumes that the rod will be adjusted from the inside of the guitar, right at the head block. It allows for about 1/8" of play which will be taken up by the sides, leaving the rod as a perfect fit inside the channel. If adjusting from another position, measure to that position instead, and add 3/4" to one leg and 1-3/4" to the other.

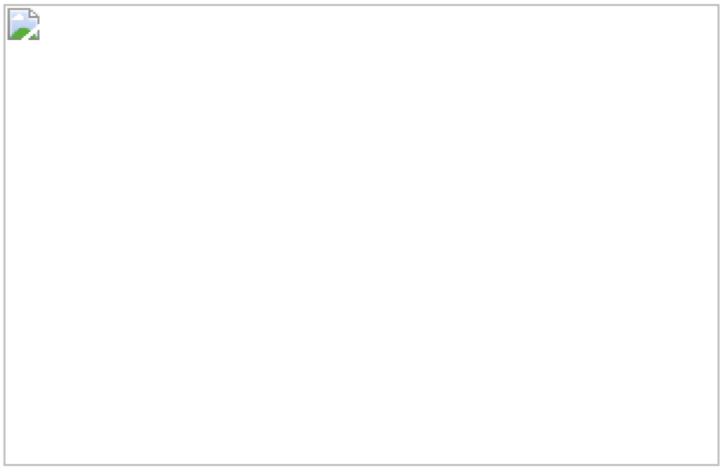
GLUING PEG HEAD VENEER

Using a piece of peg head veneer over the headstock face is an easy way to decorate this area as well as cover up all the glue joints that are visible. An acoustic guitar peg head will tend to have three visible glue joints on the headstock. One from the stacked neck cutout, and one on each side from the ears that have to be glued to the headstock to make it wider. These are ugly looking, and a piece of veneer can cover them right up.

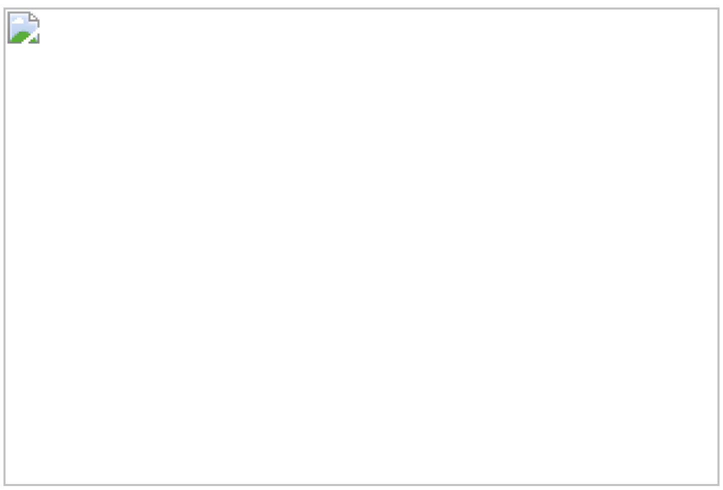
When talking about veneer, the wood used on the peg face is not exactly the same thickness as regular veneer that can be bought in a hardwood store, however it could be used. The veneer that is used most of the time is closer to 1/8" thick, and can be made by running a piece through the planer or planing a scrap by hand. Either way it is done, a guitar neck with a flat peg face and a piece of hardwood veneer will be needed.



Any wings that need to be attached to the headstock to widen it should be attached at this point, and sanded flat.



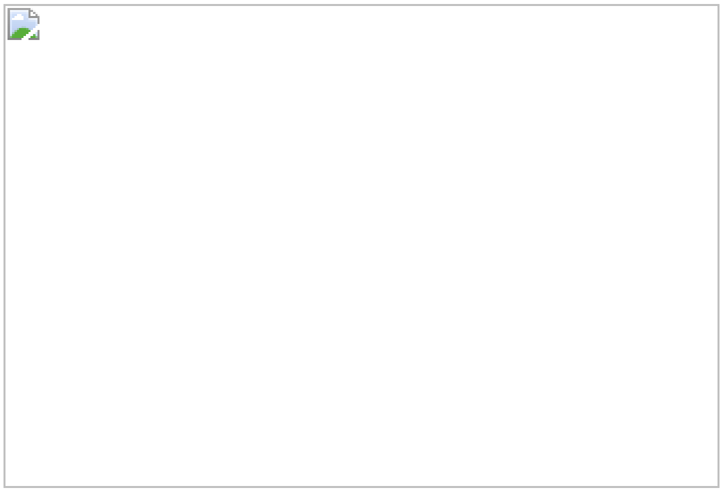
Cut the headstock to rough shape prior to fitting the veneer. This will save wood because a skinnier veneer will be needed, and it will also be easier to cut off the excess without a larger piece of veneer in the way also. Make sure the gluing surface is totally flat before gluing the veneer on, because any gaps will be easy to see on the sides of the headstock.



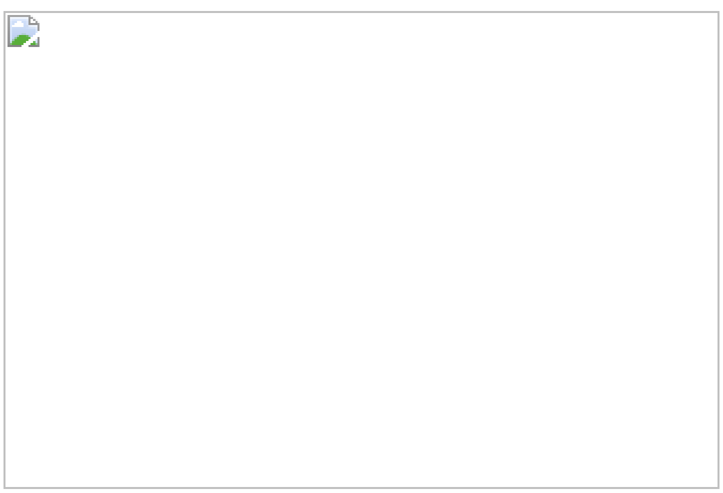
Select a piece of exotic hardwood for the peg head overlay, in this case it is Indian Rosewood. The choice was made to use this species because the bridge, and Fretboard are also Indian Rosewood. This lends a little continuity to the instrument, though some contrast on the peg head could look interesting as well.

Prepare the piece by cutting it to be just a little wider than the peg head itself, and also a little longer. When cutting, make sure to preserve

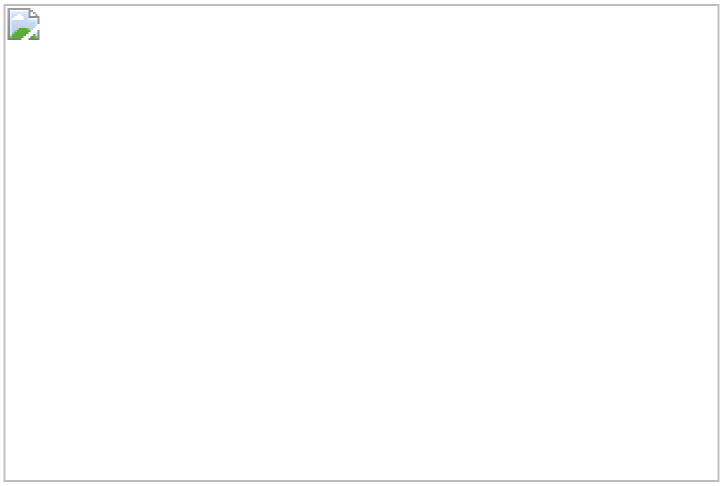
the better looking parts of the veneer so they can be displayed on the headstock when the process is finished.



Before the veneer can be glued on, it needs to have the front edge beveled slightly in order to meet the nut correctly. Since the headstock angles back, the front edge of the veneer also needs to have a slight bevel to it, in order for the edge to lay flat against the back of the nut. This is easily done by hand with a piece of sandpaper laid on a flat surface, or it can be done carefully on the belt sander. Use the nut to check for the fit, and as a guide for knowing then the sanding process is complete. Once the edge of the veneer sits flat against the back of the nut, the sanding is complete.



The bevel on the front of the veneer can be seen much easier with the nut removed as in the picture above. The bevel on the front edge and the nut end of the fretboard are perfectly parallel, which means they will hold the nut in place well.

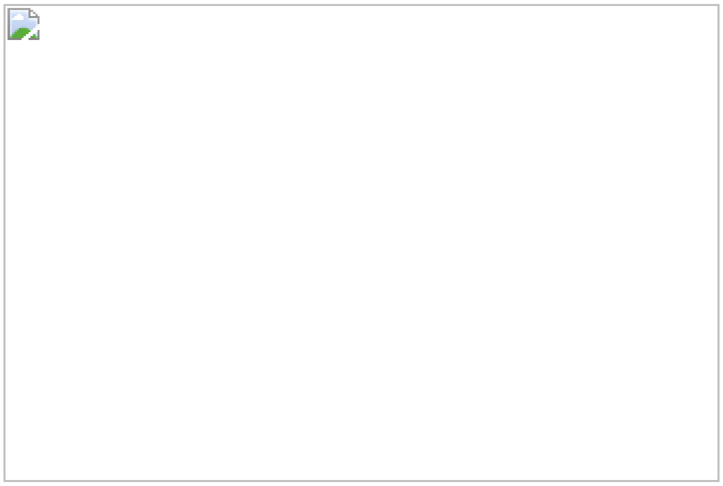


Apply glue to both the peg head as well as the veneer piece. Spread the glue with the fingers or a glue roller, so that the entire surface is completely covered from edge to edge. Make sure that when applying glue to the veneer that the side which is to be seen is not the side the glue is applied to.

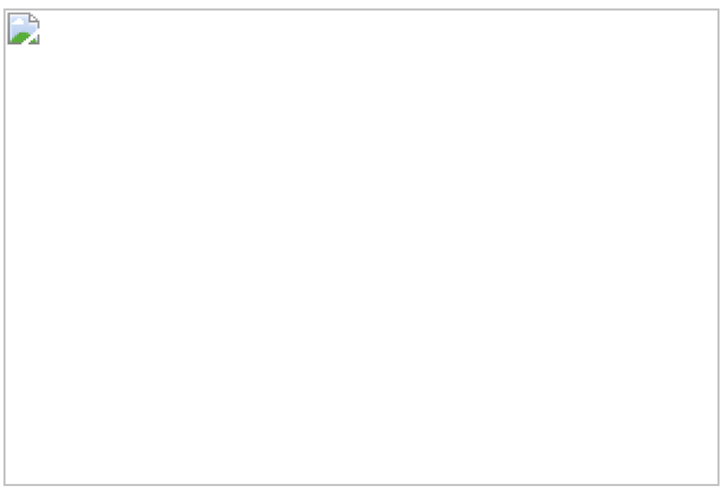
Carefully place the veneer on top of the peg head with the glue layers facing each other. Press them firmly by hand, and begin to clamp them together.

Apply clamps with light to moderate clamping pressure one at a time, until several have been placed on the headstock. After they have all been set, begin to tighten them down in order to press the joint together. There should be some glue run out as the pressure is applied, which is normal.

Lave the piece to dry overnight before removing the clamps and inspecting the joint. There should be no gaps between the veneer piece and the headstock, meaning the piece was glued well.



Use a small coping saw, band saw, or belt sander to bring the veneer down to the same size as the peg head below it. Be careful when sawing or sanding that the veneer does not crack, which can happen over the peg head, causing a difficult repair.



Once the headstock is flush, begin trimming and shaping it like normal, until the desired headstock shape is created. The two pieces are now as close to being one as they will ever be, meaning they can be shaped, sanded, and carved together without worry of them coming loose.

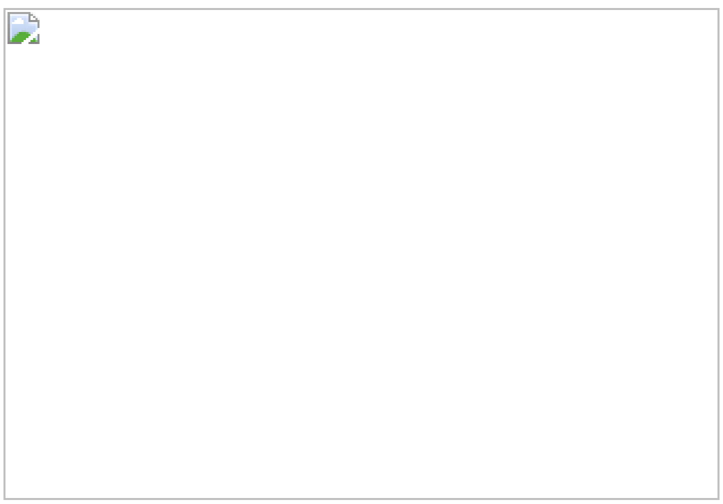
If a piece of thin veneer is being applied, it cannot be used to hold the nut in place like a thicker piece can. Simply glue it across the entire face of the headstock, and use a small chisel to flatten an area for the nut to sit in after it all dries.

There are unlimited options when working with exotic veneer and very thin pieces of wood. The headstock is a focal point of the guitar, and an interesting species of wood can really draw attention from far away.

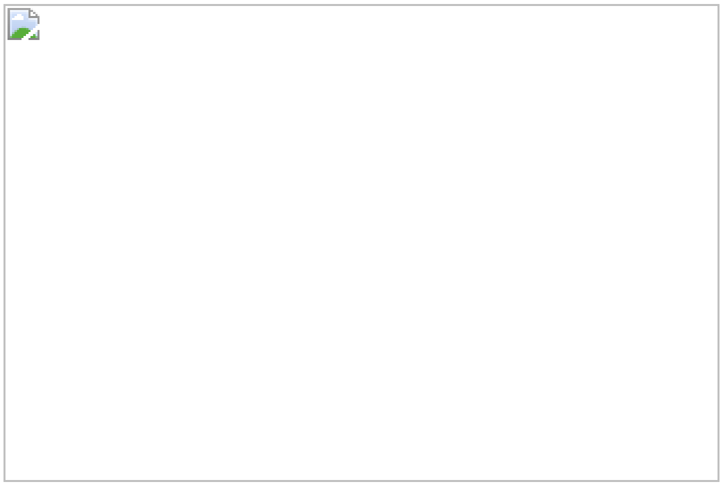
MAKING CUSTOM GUITAR LABELS

The label inside an acoustic guitar soundhole is a very important last step to making a great instrument. A label is much more than a place to record what was made and when. It is a sign of professionalism and pride in following a build all the way through to the very last detail.

A custom label is something that every guitar maker should have, even if they only intend to make one guitar. There is a strong sense of pride in filling out the soundhole label, and knowing no matter where this guitar may travel in its lifetime, your name will always be inside it.



In order to make a custom label, a computer with photo editing software is needed. This program can be as simple as some of the free programs found online, or as advanced as Photoshop. The only difference between the basic and the advanced programs is what they are capable of doing, and how long they take to learn how to use. A very simple program will be easy to figure out, however it will not come close to being able to do what a dedicated program like Photoshop can do.



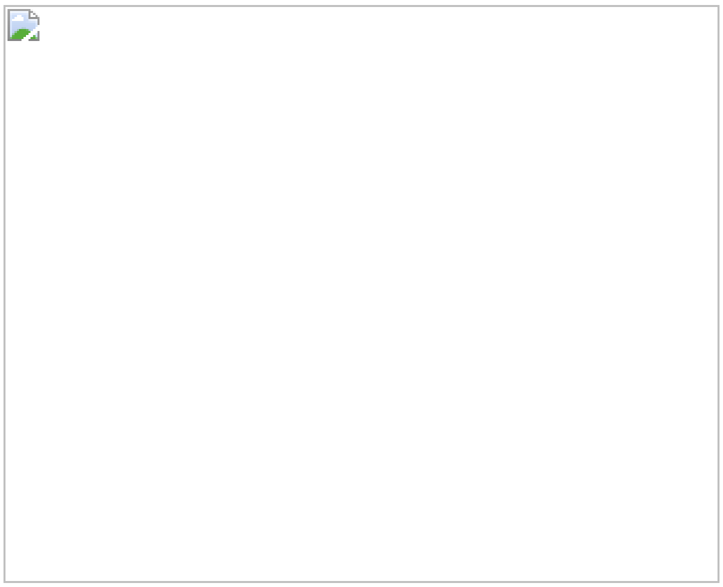
A great compromise program that has many of the tools of the advanced editors but still allows for some hands on learning is Pixlr. This is a free to use program that runs completely online and will allow anyone to do many of the same things as the more robust choices would. This is essentially a free version of the big paid programs, and it works just as well for what a guitar maker would need.

Go to www.pixlr.com and the home page will display. They have an advanced online editor that can be chosen from the options on the screen, and it is very similar to other photo editing programs.

The actual key by key details are included later on in this section for those who are interested in using Pixlr for making the labels. Unfortunately, there is not enough room to include every key stroke for every photo editing program out there, so only the free program will be

detailed here. Even if Photoshop is already on the PC being used for this label, Pixlr can still be very helpful.

The following pages are an overview of the technique for making a classic looking label, and after that the instructions for making the Pixlr label will begin.



Laying out the design is the most difficult step in creating the label, because it is very personal to the one making the label. Try looking at several other guitar labels and seeing what they have in common with each other. Also, see what features are good to have as well as which are unnecessary.

Most labels will cover the model of guitar, serial number, date made, and the name of the person who made it. This information is good to have on the label because it shows all the important facts, and keeps it simple. Anything else can be included of course, however be sure not to crowd the label too much, making it difficult to read and understand at a glance.

Start the design process with a border around the label if that is desired, and work the name of the guitar company, which may just be your name, into the label somewhere. After that, possibly include a few words about the guitar making process, or where the guitar was made. Include spaces to fill out the technical information that will be included, and leave enough space to fill those in.

For the above label, the border was created in a basic drawing program, and copied so it would be symmetrical all around the outsides. After that, the name of the guitar company was added, which is Six Gun Guitars. Then, a small sentence or two about the company, and why the guitars are unique was added to the middle. The space on the bottom is for the important data elements, like who made it, when, the serial number, and the model number.

These are typically filled in on the computer, and the label printed out as needed. The information can easily be filled out by hand just as well, though typing it out looks a little better. For an old fashioned look, try typing out the labels on a typewriter. The words will be offset slightly, giving it a vintage look which is very popular now. The only thing to look at if doing it this way, is to make sure there is enough room on the label to accommodate the size of type on the typewriter. After all, the font is not as easily changed on a typewriter as it is on the PC.

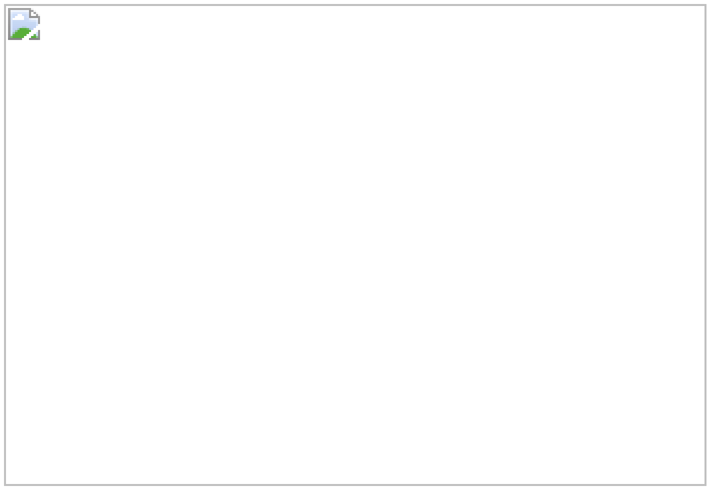
The best paper to use when printing custom guitar labels is called parchment paper, and it is available at any office supply store. It has an amber yellow color and the look of an old historical document like the Declaration Of Independence, or the Constitution. Save the label file as black writing on a white background, and simply print it on the parchment paper at home.

These labels can be printed out to fit within the borders of the back braces on the inside, and can be filled out by hand with a fine tipped permanent marker. The final dimensions are a personal choice, but 4" x 3" or a little smaller is considered normal for something that can be read through the sound hole.

For completely custom labels, fill out all the information in the computer and then print it out on the parchment paper, leaving nothing written in by hand.

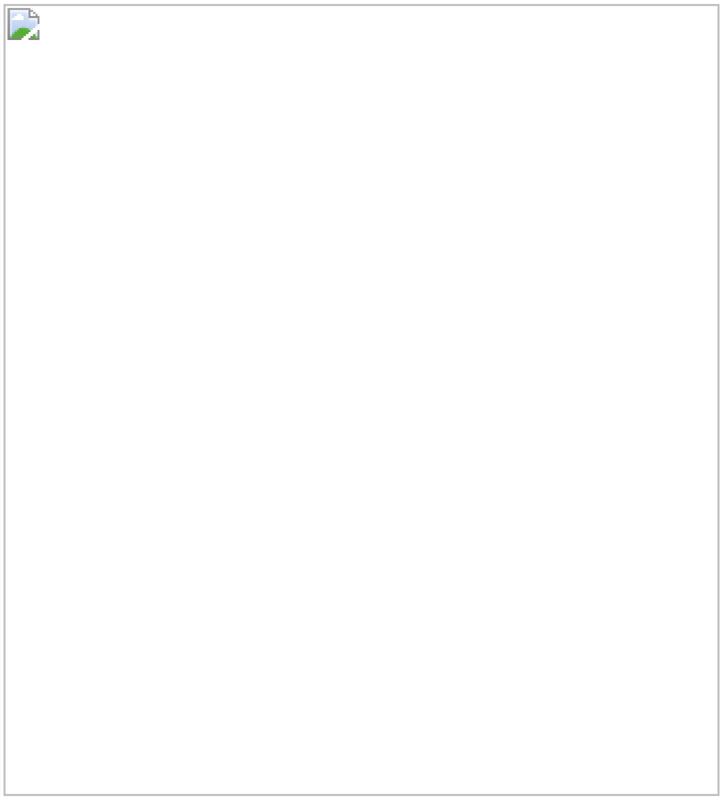
Brush some glue around the border of the label on the back side, and carefully lay it inside the guitar. Press the glued ends down against the wood and hold them until they stick. Watch the label and keep pressing the ends for a couple minutes until they do not peel up anymore. The wood glue will bond the paper to the guitar well, and as long as the glue was applied sparingly the ink will not smear either.

Step by step instructions begin on the next page on how to use Pixlr to generate a guitar soundhole label. This will be a fairly basic label, however working with the techniques taught in the instructions, a much more advanced label can be made.



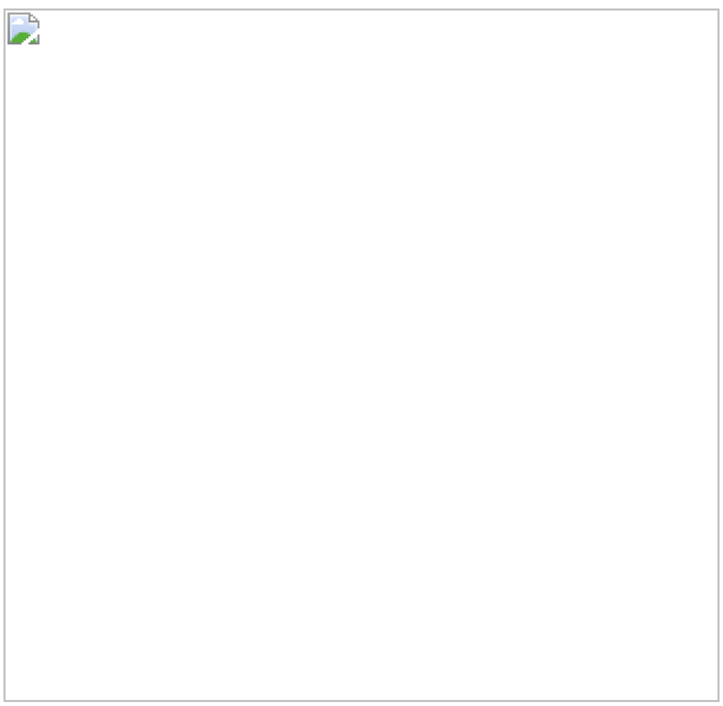
This label will be a very easy border with words in the center. The border will need to either be downloaded from the internet, or created in a drawing program like Paint. The instructions for making the basic border are in the next section. The border created for this example is a set of concentric rectangles, each a little thicker than the last. Draw it with about the same proportions as the guitar soundhole label would have, in this case it is a little wider than it is tall, which looks good for a label.

Open the internet browser on the computer and go to www.pixlr.com. Click on the advanced editor to create this label.



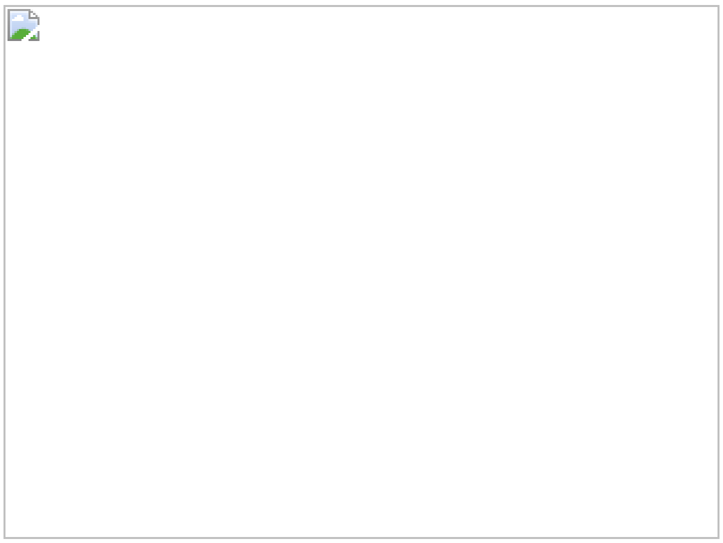
The computer will open the box seen above, and choose the second option from the top, which is to "Open Image From Computer." This will allow the already made border to be opened, and filled with the guitar company information. Find this image through Pixlr by following the menus, and open it for editing.

Once the image is opened, it will look like the above screen shot, where the image is open and ready to be edited.



Since the border has already been completed earlier, the only thing this label really needs are the words and layout. Click on the Text tool which is located in the tool section on the lower left hand side of the screen. This will bring up a box where text can be written, modified, and added to the label.

Most of the work will be done with this particular tool, since the only thing needed is to add the various pieces of text information.



The text dialog box looks like the above screen shot, and it has a few options. The actual text needs to be typed into the larger white box at the top of the window. The font can be changed with the menu in the middle, and the size, style, and color can also be changed.

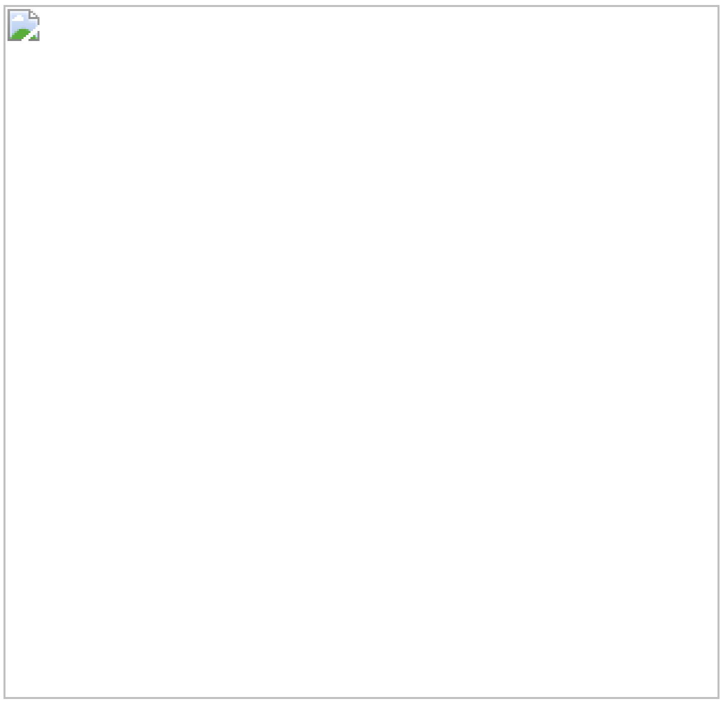
The way the label will look is largely a function of these few adjustments. They will have to be worked with and experimented with until a good looking and eye catching label design is discovered.

Begin by typing in the name of the guitar company, or however this label will be used to identify the guitars. Type the exact name into the larger box at the top, and it will appear behind on the label.

After the words have been typed, begin looking at the font choices by clicking on the middle menu in the text box. See what looks good for the name, and pick a font that captures the right feel for the guitars.

If something is typed incorrectly, just erase it and type it again. This box can be filled and deleted several times until a good name has been chosen, or the right font has been chosen.

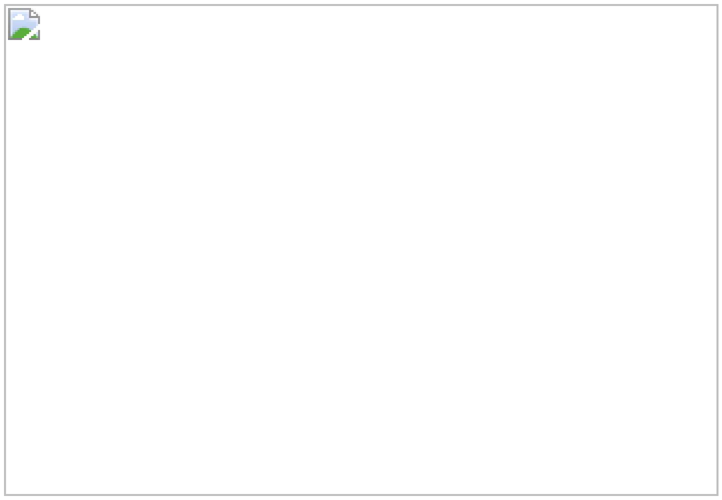
With the font and words selected, click on the size slider, and adjust it so the words fit well in the frame. The frame itself can be dragged around by the mouse later to move the words into the exact center of the label, however for now just get them inside the borders so they are not too big for the label.



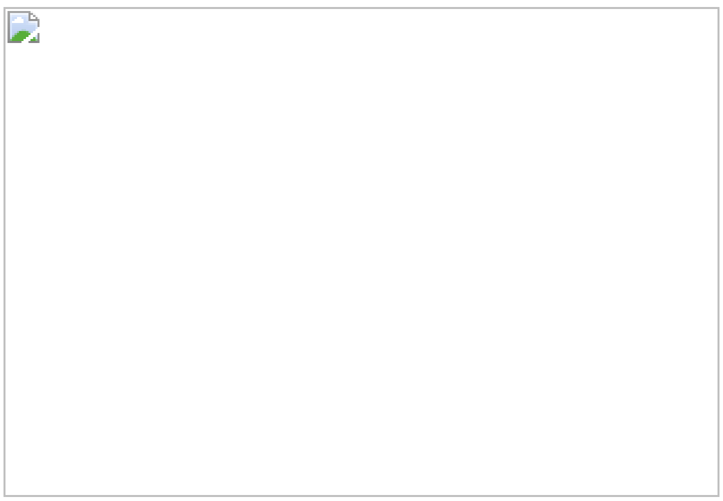
Once the main company name is in place, work on adding the rest of the details in the same way as the name was added. Click on the image while using the Text tool and a little box will appear again that can be filled with words.

If lines are wanted after the model and serial information like in the above picture, hold shift on the PC and press the button to the right of the zero over and over again. This will make the underscore symbol, which will look like a line across the label when repeated.

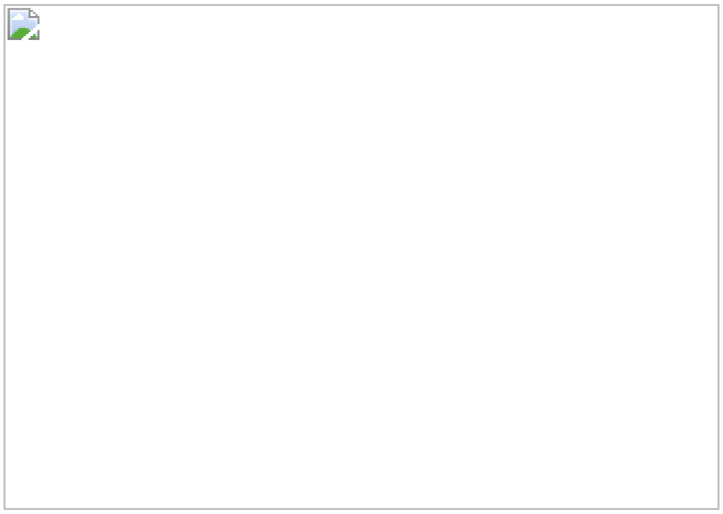
Adjust the size slider to get the fit right, and proceed to place the rest of the text the same way.



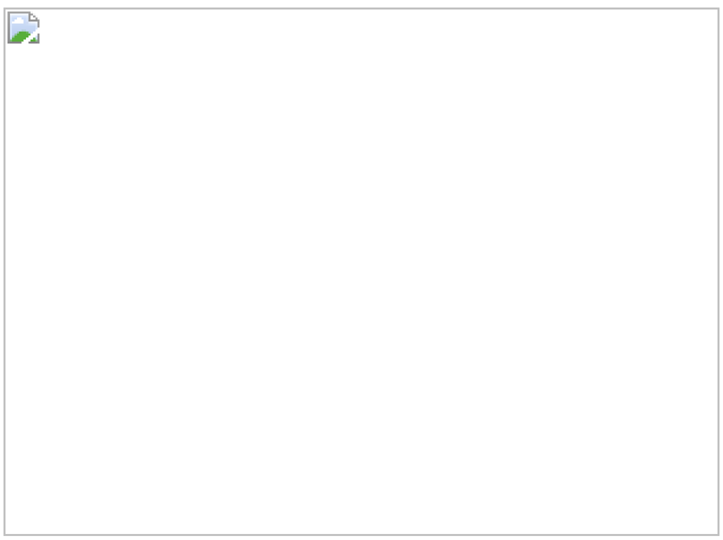
In the above example, the bottom two lines are placed where they need to be, but the top line needs to be moved down.



To move a certain piece of text, click on the text that needs to be moved on the right hand side of the screen in the layers panel.



Click and drag the layer around until it is in the place it should be. If another layer needs to be moved, click on it the same way on the right, then move it freely on the label.



Once the final design has been worked out, add a few words about the guitar company if that is something that is desired. Adding something about how the guitars are made or why, can really set off a guitar label. Check the layout while it is on the computer, and make any necessary changes.

To save the label, click on "File" from the top menu, then "Save," and pick a good name for the label to be saved under. Do not save it

as the same name as the border was saved, otherwise it will save it over the border, and it will be lost.

To print the label, it must be opened in a form of word processing software, and printed from there. Open the word processing program on the computer and insert the picture. Use the sizing options to get it to the needed size and print it out.

Check the printout against the actual guitar to see if it is a good fit, and resize if necessary. The label will be cut out with a small border around it of maybe 1/4" to 1/8" depending on style. Leave a little room for this when the label is cut out.

Once the size and look is where it needs to be, print out the label on parchment paper from an office supply store. This will give it the look and the class of a custom guitar label.

Project Notes:

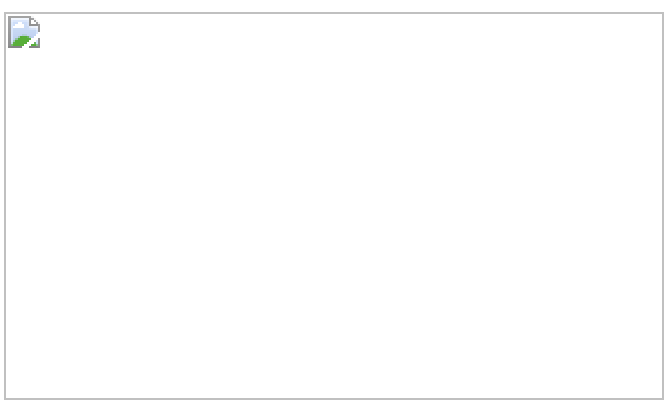
The nice thing about working in the computer environment is that a label can be made, re-designed, made again, and tweaked until perfect without ruining a single piece of paper. Literally dozens of labels can be created on the computer to see how they would look, and changes can easily be made in the future if need be.

Designing a guitar label should be a very proud part of guitar making. When the people look inside that guitar, they should see something that makes you proud to be a guitar maker.

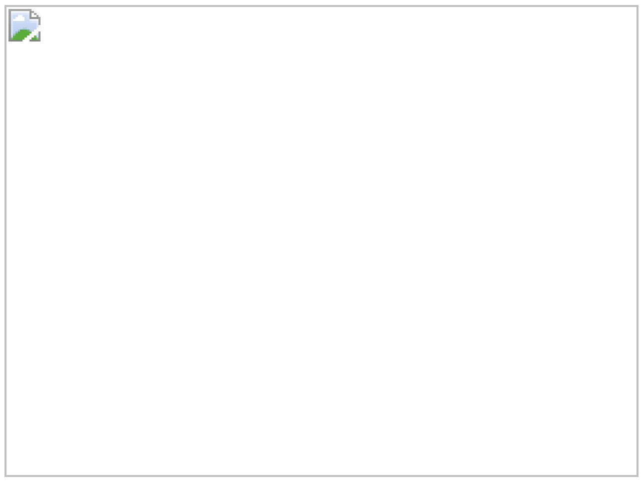
CUSTOM LABELS TWO: EASY VERSION

An easier method of making a custom guitar label requires a drawing program like Paint, and parchment paper. This does not have the vast array of options that Pixlr does, however it will not require photo editing knowledge either. This is a basic way to make a clean looking label, that will look good in any guitar soundhole.

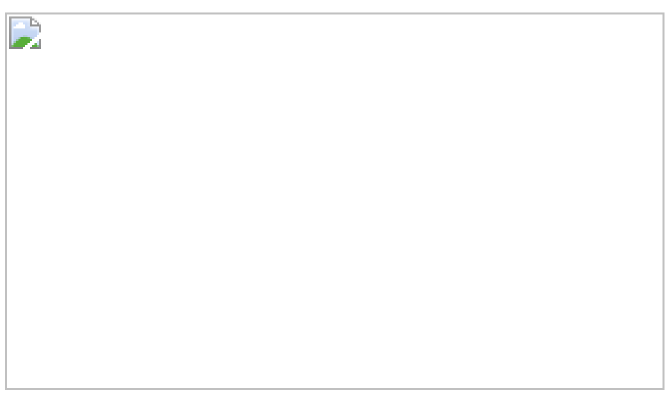
The first thing to do with making a custom label, is experiment with adding a border around the outside. This is not required, however a border wraps everything up nicely together.



The border can be oval shaped or square, depending on personal preference, and is made by drawing concentric shapes with the program on the computer. This should be printed out after it has been drawn in order to see if it is the right size for gluing in the soundhole, and also to test font sizes. Try printing out the label with a few random letters written in it, just to make sure they are easily readable.

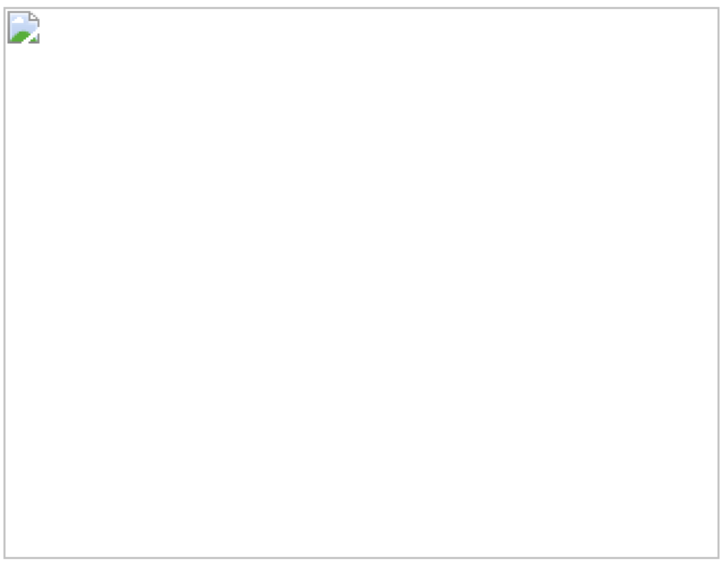


Once a font and a border are decided upon, fill out the important information inside, adding lines if desired for the information to be written by hand later on. Print this out again and take a look at the layout. It is easy to erase and add things, so make any changes that need to be done, and print it again. There is a good possibility that the label can have much more on it than they do here in the diagrams, which is completely optional.



Once the layout is perfected, and it prints out well, save a couple copies in different places on the computer. This is a safeguard against the file accidentally being modified or deleted, and may come in handy one day. Print out the label on parchment paper from an office supply store, and fill in the guitar information by hand. If the information is to be typed on the computer, add it in the drawing program before printing.

It is wise to save a blank label, and add the model/date/serial information on the computer each time before printing. This way the main label is always consistent, no matter what model of guitar it goes in.



Paint is a program that comes with all Microsoft PC's and is a basic drawing program that allows easy two dimensional drawings to be created on the computer. Take a moment to locate the program, and start it.

The process for making the series of concentric squares or circles in Paint begins with opening the program, and selecting the square maker from the shapes list. This tool will allow the drawing of squares and rectangles by simply dragging the mouse from one area on the screen to another.

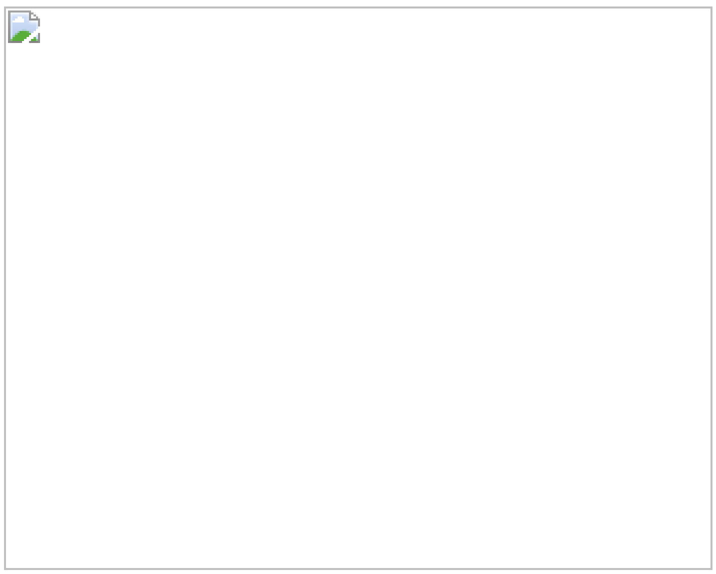
Next to the shape selector in the program there is a box where the width of the line can be changed. Though versions of this program may change over the years, there will always be a place to select the shape being made and the size of the line.

Any shape can be used for a guitar label, however the rectangle is the easiest, and will work to demonstrate the technique. Circles are shown on the previous page and make a good looking label as well, though rectangles are the standard.

Draw the first rectangle by right clicking with the mouse at the top left had part of the canvas, and while holding the mouse button down, move it down and to the right. It will create a box as long as the mouse button is held down, and it will leave the box on the screen when it is let go.

Experiment a little by dragging the mouse around while adding a rectangle and see what the results are. The design does not have to be exactly as it is in this example, because everyone has a little different taste.

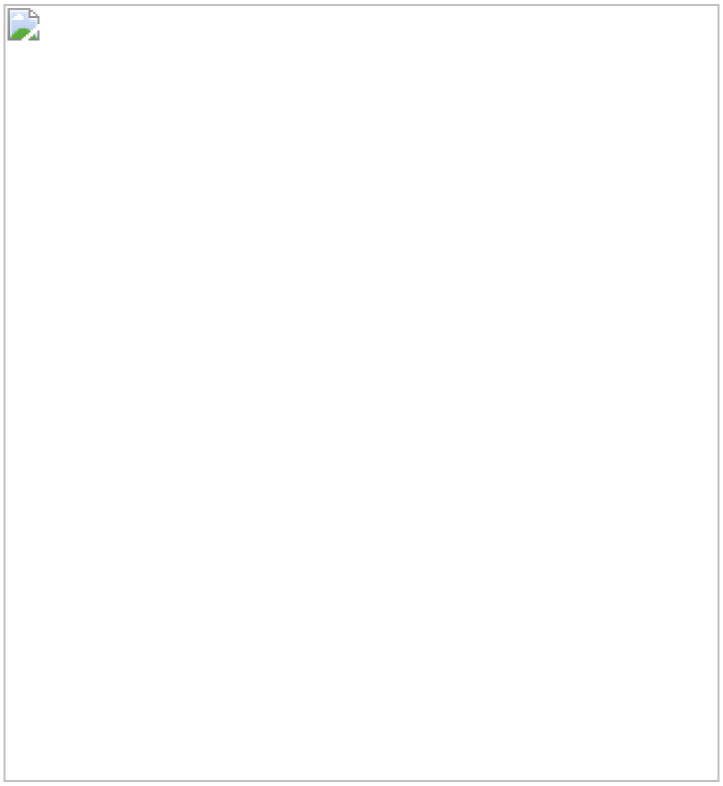
If the canvas (the white box being drawn on) is too small or large, grab the small square on the lower right corner of the canvas and drag it larger or smaller.



If a mistake is made, and a square is not placed where it should be, there are a couple options for moving it. As long as nowhere else has been clicked after the square was released, the arrow keys on the keyboard will nudge the square in any direction in very small increments. Use these keys to get the square in position, and then click somewhere outside the square to lock it in place.

If the placement has already been locked, and the up and down arrows do not move the square at all, simply click on the Undo button on the top of the screen and it will undo the last action taken, which was making the square. This small button is next to the save button at the very top left hand side of the screen, and looks like an arrow curved backwards.

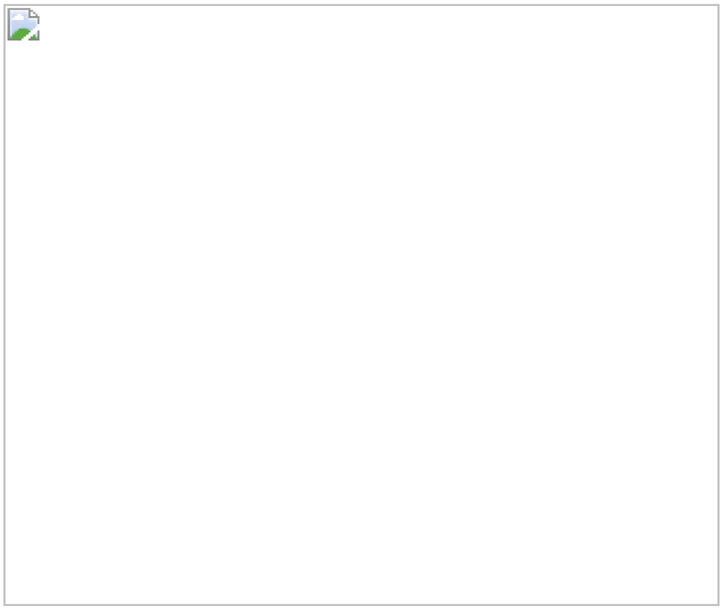
Pressing the Undo button many times in a row will continue to remove previous actions until the canvas is blank, which is the very beginning when the program was opened.



Change the size of the line making the rectangle after the first one is placed, and place a second inside of it. Try to make the line a few sizes smaller so there is enough contrast between the two sizes. Move this rectangle around until it is even on all sides.

Go back to the line thickness selector and choose another size for the third rectangle. In this case, the rectangle started out large, then small, and now it will go back to large again for the final inside square.

Drag the square into place, and use the arrow buttons to nudge it around where it needs to be. Once the rectangle is evenly placed inside the other two, click off of the canvas somewhere and it will set the final rectangle.



When the border for the label looks good, click on the button indicated by the arrow to bring up the save menu. Save the picture in a place where it can easily be found again and worked with, like the desktop.

This file is now ready to be opened in Pixlr and the rest of the label graphics placed where they need to be. Refer to the previous section for directions on how to turn this simple border into a professional looking guitar label, using either Pixlr or Paint.

Project Notes:

The simple design of three concentric squares was chosen for this example because it is easy enough that just about anyone with mild computing experience can create it. This is certainly not the creative limit to even a simple program like Paint however.

There are several adjustments that can be made in the program, including but not limited to line color, shading color, and the main shape being made. Experiment with these different adjustments and try to come up with something creative and original.

Try filling in the gaps between the concentric rectangles with different shades of gray, and seeing what it looks like. Perhaps the whole label should have a very light gray shade to it, which would give it a slightly darkened look.

There are also brush options that will allow the user to draw freehand, though this is fairly difficult with a mouse. If something is drawn by hand using the mouse and there are errors, they can be erased by using the eraser tool, and the zoom functions to get in really close. This way only what needs to be erased ends up being erased.

Chapter Six

INLAY TECHNIQUES

The acoustic guitar has a few areas where inlay is required and expected. Those areas include the rosette area, the fretboard top, the fretboard side, and the peg head. After these locations, everything else is strictly for extra embellishment.

The topics being presented in this chapter are designed to show how ordinary tools and basic wood working methods can be used to create these inlays. The art of advanced inlaying is a skill all its own, with specific tools and techniques. The artists create absolutely amazing pictures in wood, and truly showcase the art. As beautiful as it is, it is beyond the scope of this book, and beyond mine as well.

The techniques that will be demonstrated here show how to accomplish the standard inlays with easier methods than before. They include using templates and common tools to assist in making the standard inlays better. These projects will have a similar look to the other methods of inlaying, but will be able to be accomplished by anyone.

Inlaying can require years of time and effort to be able to work with very intense patterns and several overlapping materials. This kind of inlaying is usually done by people who do nothing but inlay, and do not themselves build acoustic guitars. Inlaying can be pursued to any depth desired, though for basic guitar making only a few techniques are really needed.

As a guitar maker, the most difficult inlay is probably the headstock, because it will most times have a bit more elaborate pattern than a simple round dot. Using the techniques described in this chapter, a template and guide can be used to help the process along, or it could be made easier by doing it with epoxy and stone. There are several ways to make the job easier and better looking, and for basic inlaying, the following techniques are really all that will ever be needed.

When making the first few instruments, stick to a simple design and incorporate the exotic wood fret markers explained in this section. They will add some embellishment, but not be very much more difficult to inlay than standard dots. Also, consider making a template for a small geometric or floral inlay for the headstock. It can be routed out with a Dremel tool and then filled with either InLace or epoxy and stone fragments. This way a simple design is still possible, but with a few interesting additions that will not be incredibly difficult to accomplish.

In This Section We Will Cover:

Making custom fret dot inlays in many colors from scrap, using a plug cutter. See here.

Using old bullet cases as inlays on fretboards, and how to prepare and work with them. See here.

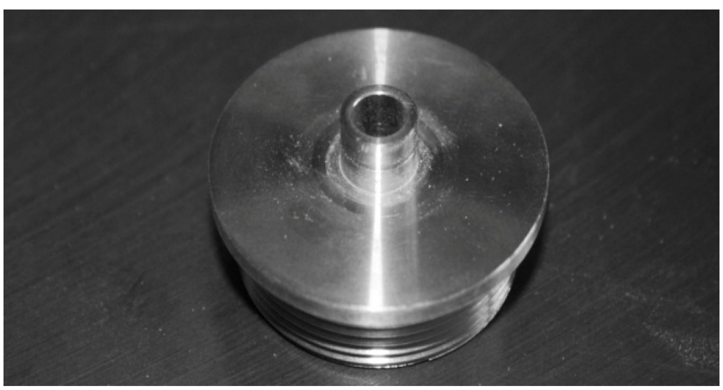
Inlaying square markers made from Abalone with a custom ground chisel. See here.

Using epoxy and stone to create interesting looking dot inlays for the fretboard. See here.

How to use InLace to make very attractive side dots on an acoustic guitar. See here.

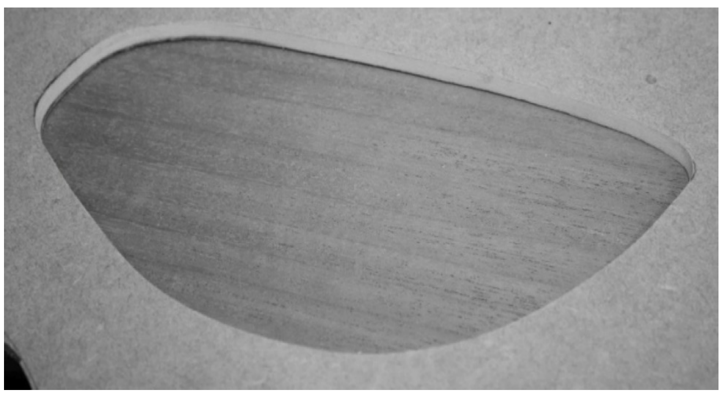
How to use Pixlr to create free custom inlay pattern templates on the computer. See here.

How to inlay perfectly centered brass dots into bridge pins easily and quickly. See here.



The router inlay kit, and how to make perfectly fitting inlays easily. See here.

How to center the inlay bushing system for perfectly cut inlay pieces every time. See here.



Templates, and how to make them to use with the router inlay kit. See here.

Alternate methods of making templates, by hand, and with a drill press. See here.

Project Notes:

To practice any one of these techniques, use a test board to do each inlay. Do one of these at a time, and fully complete it before moving on to the next inlay to repeat the procedure. It does no good to do the first step ten times, then the second step ten times, and so on. Completely finish each practice inlay before moving on to the next one, and each time it is performed the process will get easier, and the results will get better looking.

CUSTOM INLAY DOTS

The fretboard is a great place to express some creativity, and the dots that mark the frets are an easy place to begin. Standard dots come in mother of pearl and abalone, however the choice of two colors can get old. Using this technique, any piece of scrap wood can be turned into a fret dot inlay, easily and quickly. The advantage of inlaying with wood is that the color and figure choices are almost endless. Plus, this is a very easy feature to allow a customer to choose a custom option with. Offering a choice of several different species of fret markers makes the guitar that much more custom.

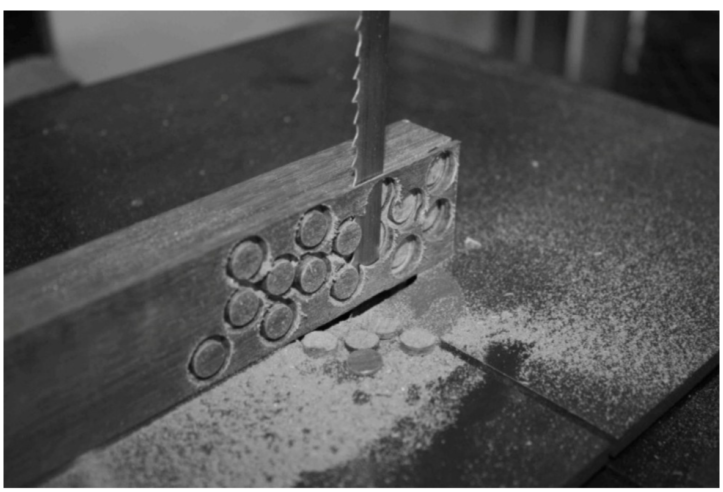
Having always been a big fan of interesting and exotic species of wood, making the fret markers from wood was just a natural step. The material is already in the shop just waiting to be used, and there is room on almost any scrap piece to squeeze out a few dots.

The only special tool that is needed to make the dots is a plug cutter. These come in a variety of shapes and designs, however way they work is similar. The plug cutter is put into a drill press, and when it contacts the wood, it leaves a cylindrical plug. These are normally used to fill screw holes to hide them on cabinet work, but they are also perfect for guitar making. Instead of making a thick plug for hiding a screw, we will be making many thin plugs and inlaying them.

Plug Cutters come in a large number of sizes, however the 1/4" and the 3/8" are really the only ones that should ever be needed. Of the two styles pictured in the top right hand column, the one on the right seems to make a slightly smoother plug on the outside edge. This is really the most important part of the plug, since it will need to fit snugly into a hole so the inlay looks nice. They come in single packs and in sets, and a small set with the two already mentioned sizes is worth the money. The 3/8" will be used throughout this example.

Once a plug cutter is purchased, the next step is to find suitable material to make attractive inlay dots from. Literally any good looking species of wood will make good looking inlay dots, and the more interesting the coloring the better. Padauk, Bubinga, Rosewood, Walnut, figured Maple, and Purple Heart make excellent fret dots. A great place to find plenty of scrap for fret dot making is the cutoff bin at the local hardwood store. Most of them keep a bin of cutoffs that they sell for incredibly cheap. Pick up several of these in different species and colors.

Chuck the plug cutter in a drill press, and start drilling out plugs with the cutter. Space them apart so they do not touch each other, and only go about 1/4" deep before pulling the bit out. Make at least 20-30 plugs, or cover the entire face of the board with as many as can fit. Due to the large forces involved with a plug cutter, doing this operation with a hand drill will be a little tough, not to mention possibly dangerous. A drill press is the safest and the most sturdy method for making these plugs.



The next step is to free all those dots from the piece of scrap. The easiest way to do this is with a band saw. Saw just deep enough to cut through the bottom of the plugs, which will eject them from the wood. The actual pieces should be a little thicker than 1/8" when they come off the

piece of wood. Placing the hand a few inches to the right of the blade is good practice, because the plugs fly out. This way they will bounce off the hand and land on the band saw table.

They can also be cut out without machines using a hand saw, though this will take a little longer. Clamp the board in such a manner that the dots will fall on the bench when they are sawn through. This will minimize the amount of times that sawing will have to stop, to go find flying dots.

This tray shows the cutter on the left, and several different species of fret dots. Once this way of making fret dots is learned, making several at one time is worth the extra few minutes of effort. Go through several pieces of scrap and make a nice little selection of fret dots to have and use when needed. They can be stored together like the picture above, or they can be stored in individual small envelopes with the species name written on them. Either way of storage works, though the envelope method will better guarantee they do not get mixed up.

The only thing that is left is to inlay the dots on the fretboard. The easiest way to accomplish this is to use a Forstner bit of the same size as the plug cutter to make the holes. The advantage to a Forstner bit is that it drills a hole with vertical sides, does not rip out the wood, and does not wander. A twist drill bit does all three, unless very careful, and a little lucky. A Forstner set is worth the few dollar investment, and will be used for a variety of things around the shop.

Chuck the matching Forstner bit, in this case a 3/8" bit. Set a depth stop on the press at a little less than the thickness of the dots. In this case it will be set at right about 1/8", because the plugs are a little bigger than 1/8".

The thing to look for when doing this on a curved surface like a fretboard, is to make sure the sides of the hole are deep enough to hold the dot, and the middle of the hole is not too deep that the dot sits lower than the surface of the fretboard. It is best to test this by drilling a hole that is more shallow than necessary, and checking the fit before committing all the rest of the holes to the same fate.

Once the holes are drilled, fill with wood glue, set the dots using a hammer for help, and sand them flush once the glue has dried. Make sure to get glue on the walls of the hole as well as the bottom, so the joining edges on the inlay are less visible, and the piece is more secure.

BRASS CASE INLAY

A great inlay to use for a gun enthusiast is old pistol or rifle cases. These are available in a variety of sizes, that correspond to the caliber of the round to be fired from it. There is a lot of history in firearms and cartridges, especially the .45 Long Colt.

This was the cartridge that won the west, because it was usable in either the single action pistol or the lever action rifle. The cowboy had to carry around both of these weapons years ago, and no matter which one he wanted to use, he always had the right ammunition.

Another historic cartridge is the .223, which is the less powerful version of the round used in the US Military M-16 rifle. This has a smaller diameter than the .45 Colt, so it can be used into the higher frets without touching the fret wire.

Obtaining the spent shells is a bit problematic for the non-shooter, though there are many ways to get around this. Usually in a group of friends, someone is a shooter, or they know a person who does. If asked, they would most likely not mind giving up a couple dozen spent cases that can be inlaid.

Another way to get spent brass would be to visit a local shooting range, and ask the manager for some of their used shells. Explain the project to the manager first, because most likely several people ask him for free brass every day. Those people are just looking for cheap brass to re-load, and the manager will be used to saying no. Making a guitar with old .45 inlays however, that will be very new to him or her.

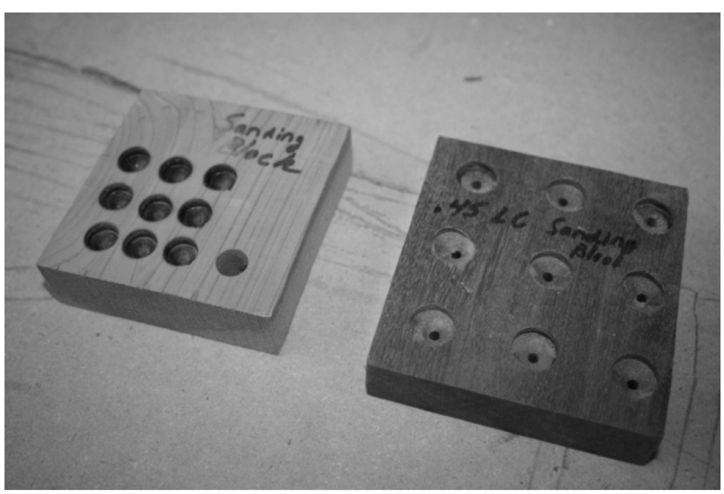
Lastly, the kind of brass that is needed has been fired, and still has the primers in place. The primer is the little round button looking thing in the bottom center of each case. The centers have been struck by the firing pin of the gun, leaving the dimple that can be seen. Using cases that have the primers removed will not look very good, because of the gaping hole that will be in the middle of them. Also, using cases that have live primers loaded into them is very dangerous. If a primer were to explode, it could remove fingers. Fired cartridges have nothing left in them to explode, and are safe to use on the guitar neck.

Find several cases that are all the same size and color. There are a wide variety of brass colors out there, as well as some silver and some

steel cases. To inlay a fretboard up to the 12th fret, seven cases are needed to cover all the odd frets except eleven, and two inlays for number twelve. To go all the way to the 20th fret, ten cases will be needed.

The first thing that has to be done to the cases to get them ready for inlaying, is to cut off the majority of the material not being used. Grab each case in a vise being careful not to smash it, and saw off everything but the bottom 1/4" of brass. The sawn off upper portion is waste, and can be thrown away.

Use a hack saw with a metal cutting blade to do the sawing, and be careful when sawing through the center of the case, as it likes to grab the thin metal.



The next requirement is to make a block that will help to get all the cases down to the exact thickness they need to be for inlaying. This is made from a piece of scrap, with holes drilled to a precise depth.

These inlays behave a little different than regular wood or shell inlays. Normally, the pieces are inlaid and then sanded down to match the surface. With this kind of inlay, it cannot be sanded at all. If it is, the detail of the case will be lost, and it will just look like a big brass lump was inlaid. The block in the picture above will help make all the case inlays uniform.

Using a piece of scrap, set the depth stop on the drill press to 1/8", and drill several holes spaced about 1/4" away from each other. There is no right or wrong amount of holes to drill, though more will mean less trips to the sander. The drill bit needs to be just bigger than the diameter of the cases, and being a little snug is not a bad thing.

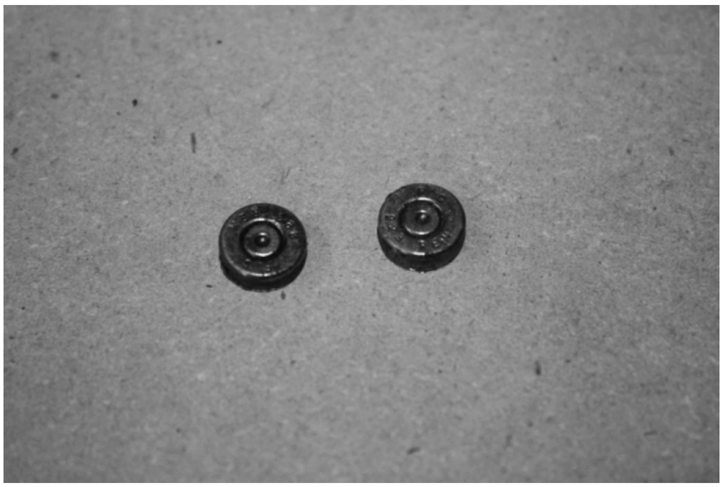
After the main holes have been drilled, follow through the center of the holes with a small drill bit, going all the way through. This will allow a toothpick or other thin item to be pushed through from behind and pop out the cases.

Insert the cut off cases into the holes of the block like in the above diagram. The open ends should be facing up. Make sure if it is a snug fit that the brass is pressed all the way into the bottom of the block, because this will determine how thick the final inlays are.

Carefully take the block to the belt sander and remove all the excess brass until the belt touches the wood. Do not remove any wood if possible, because it will change the thickness of the inlays.

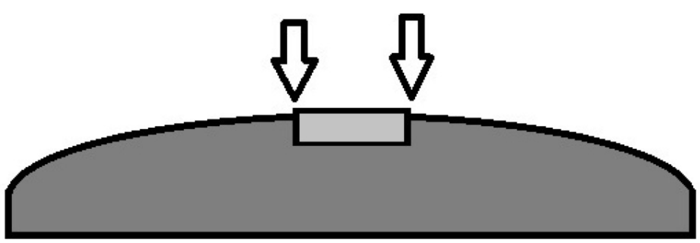
When the brass inlays come off the belt sander they will be very hot, so do not touch them. Use a toothpick or a piece of purfling to poke them out through the back of the block. Let them fall on the bench, and allow them several minutes to cool. The sanding process will burn the block, but it will still work for many more batches of inlays. The pieces will even burn the top of the bench as they come off the sander, so if this is an issue, make sure to let them fall on a scrap piece of wood that can be discarded.

The brass should look like the above picture when the sanding has been completed. There are two brass cases in the middle row, on the left and in the center. These happen to be .223 cases for a guitar that was specially made for a member of the United States Marine Corps. He thought it was a very nice touch.

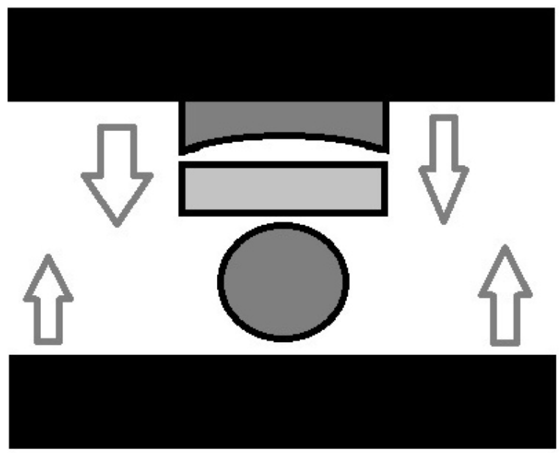


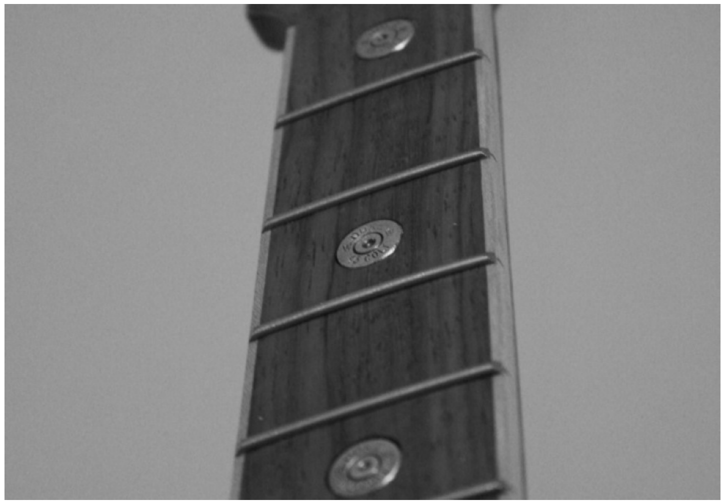
Once the cases have cooled, they can be inspected and cleaned. Using any kind of abrasive on the shells is completely out of the question, because it will destroy the details on the ends of the cases. Instead, clean them with soapy water and a toothbrush, and follow up with a brass polish if needed. Picking brass that does not look like a mile of bad road in the beginning, will greatly diminish the time spent cleaning them in the end. However, even the cleanest brass will attract resins from the wood when it heats up during the belt sanding.

Throw out any cases that cannot be cleaned to satisfaction, and make more if needed. It is nice to have several of these on hand during the inlay process, just in case one or two need to be tossed for whatever reason.



The inlay process itself is fairly straight forward, though there is one difference. The top of the inlay is flat, and inlaying it into a board with a radius on it is a bit of a challenge. The hole needs to be drilled to the same depth as the inlay, however the sides will stick out a little bit over the top of the fretboard. This cannot be felt by the fingers as long as the top and bottom (12 and 6 o'clock) positions are inlaid flush with the fretboard, even on large caliber cases like the .45 Colt. The cases could be bent slightly before inlaying using a vise with a curved caul, however this is not necessary.



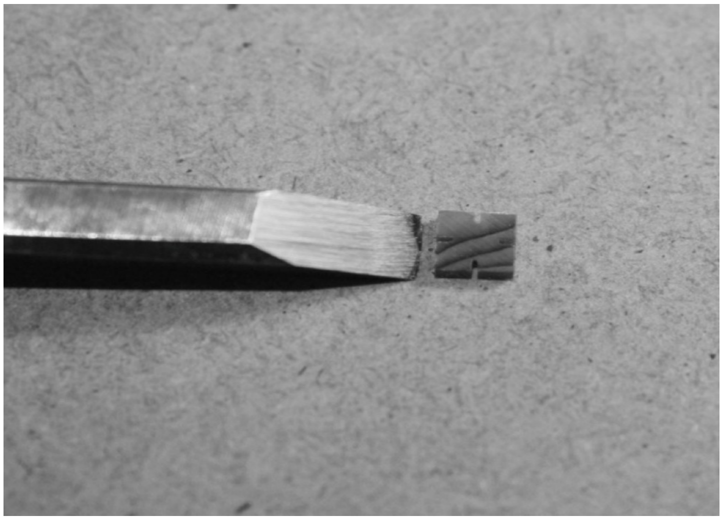
If they absolutely have to be bent before inlaying the cases, they can be bent in a fixture like in the above diagram. The black areas are the vise faces, and the grey curved piece on the upper face is a curved wooden caul. The circle is a metal rod, which will bear against the back of the inlay and form it into the wooden caul. This will force the inlay into a curve, though the primers may have to be glued back in afterwards.

Mix up a batch of two part epoxy to set the inlay into the fretboard. Only apply it under the inlay, and do not put in enough to allow any to squeeze out when it is pressed into position. The squeeze out cannot be sanded off without also sanding the brass, and that will leave marks that cannot be repaired.

The picture above shows a custom guitar made with .45 Colt shell inlays that go all the way to the 12th fret. After that they are too large to continue with, however the neck came out really nice. The main fretboard is Padauk, and the brass gives a nice contrast against it.

ABALONE INLAY DIAMONDS

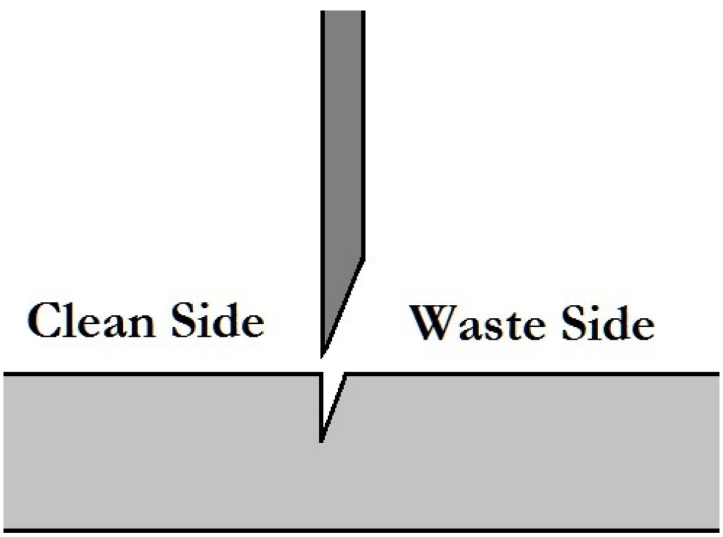
An easy first step into inlaying a shape that cannot be done with a drill bit is to start with small squares. These require a different technique than when inlaying round dots, but they can still be done with hand tools. In fact, square diamonds are easier to do with a chisel than they are to do with a Dremel and router.

Inlay squares or diamonds come in a variety of sizes to suit any fretboard, and they are made from green abalone or mother of pearl. The example above is a 1/4" square green abalone piece, that has small notches in the flat sides to give it some additional character. These can be obtained from any guitar supply house, or from any place that sells shell for inlaying.

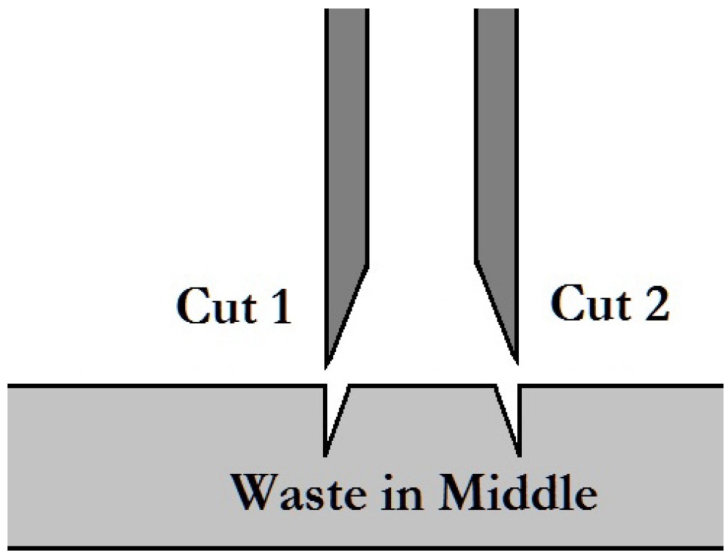


The trick to getting a perfect cavity made in the fretboard without any gaps, is to use a chisel that is exactly the same size as the inlay. One can be bought that is the correct size, however if one cannot be found there are instructions in chapter two that teach how to make a custom sized chisel.

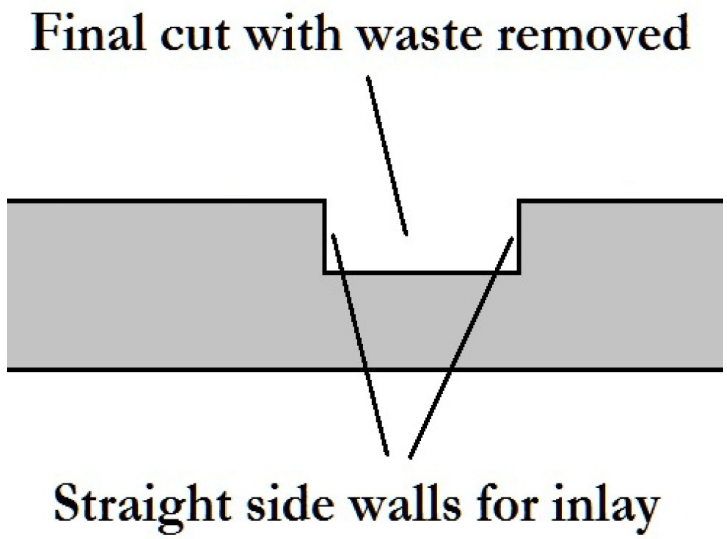
How a chisel works to remove wood is important to know before actually trying to inlay something with it. There are two things that have to be done correctly in order for the cavity made by the chisel to be good for an inlay.



When a chisel is pressed vertically into a piece of wood, it cuts the fibers and creates an indentation in the same shape as the cutting surface. The flat side of the chisel leaves a vertical cut surface, and the angled side leaves a area of compressed wood. It is important to place the chisel so the compressed wood area is always in the waste section of the inlay. This means the section that will be removed to make room for the inlay piece. The clean side needs to always be facing the outside, which will leave the best and flattest edge behind.

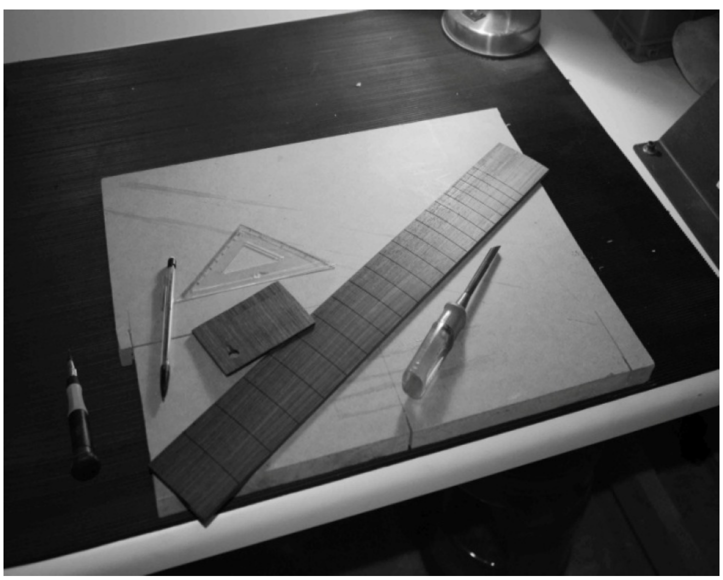


This diagram shows how two cuts would be made to remove the piece in the center. Notice how each cut leaves the straight part of the hole on the outside, and the compressed and angled part on the inside. The middle area will be removed anyway, so it does not matter how that area looks. The outsides are what is the most important to keep nice looking.



This diagram shows what the same piece would look like once the waste in the middle was removed. The side walls are straight because of how the chisel was used, and the inlay can now fit in snugly for gluing.

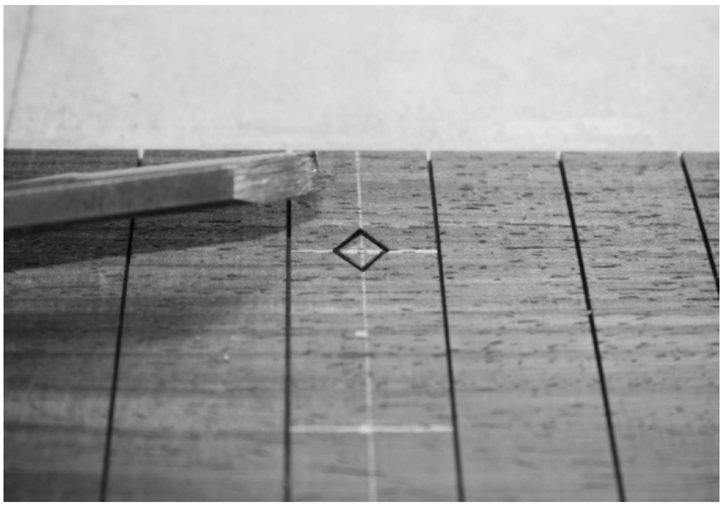
It is important to be aware when using the chisel that it must enter the wood vertically, and the flat face must be to the outside of the waste area, to create a cavity with straight side walls.



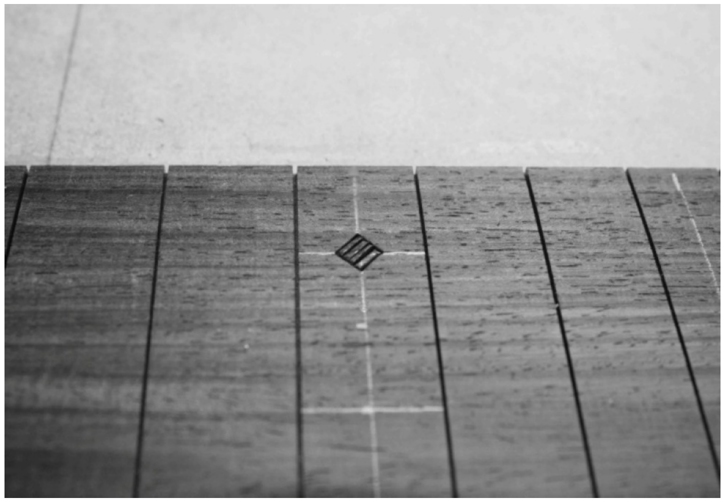
The tools required to complete the actual removal of material for the inlay are a small square, sharp pencil, chisel, fretboard, and a good

source of light. The layout is marked first, using the straight edge and the pencil. It is easiest to mark the center of the fret box with an X that connects all the corners, however that will not help with the inlaying so it is done a little different.

Draw a center line down the length of the fretboard, and in each fret box that will be getting an inlay, draw a horizontal line through the middle, which will create a plus sign.

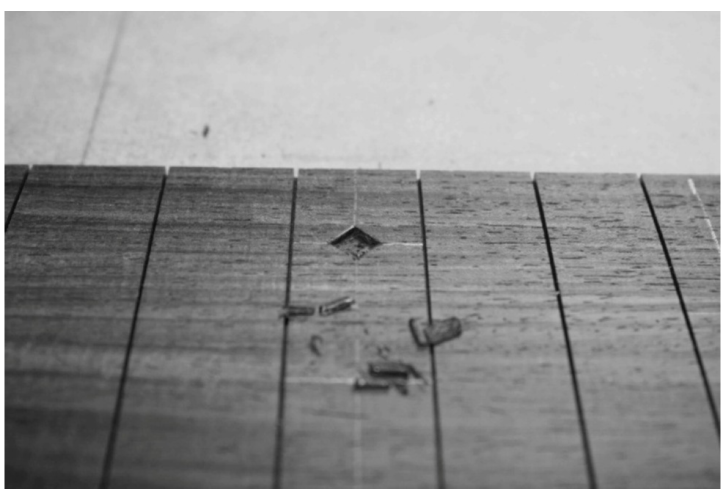


The chisel is used to connect the lines that will create the outline of the inlay, which is a matter of lining it up using the lines as a guide. In the picture, each line is connected with one punch of the chisel, and this creates a square shape. The bevel on the chisel is kept facing inwards on each plunge, which is why the area inside the square looks a little compressed. Plunge in almost the same depth as the inlay, but not too far otherwise the inlay will be below the surface after it is glued.

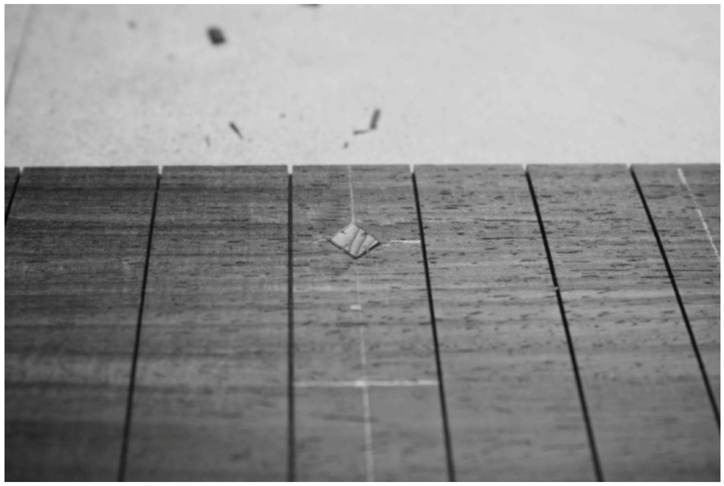


Once the outline has been established, the middle waste portion needs to be removed. With the same chisel, plunge into the waste portion 3-4 more times, creating several cuts as seen in the picture above. This will help with the removal of the waste material by making it smaller and easier to loosen.

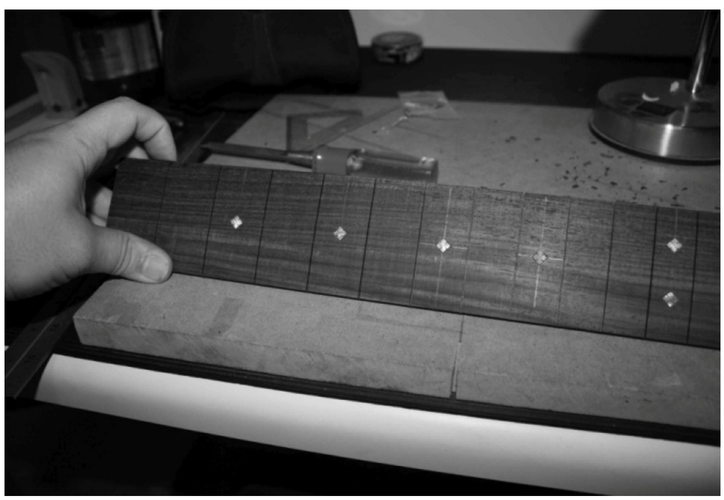
Make the small plunges in one direction only, as it is does not make the wood removal any easier to go the other way and make tiny little squares of the waste material.



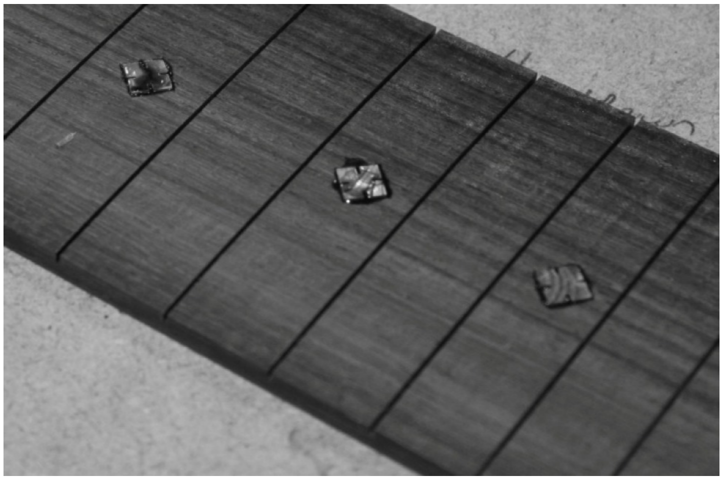
Using the chisel, remove the waste from the center being careful not to pry against the edges of the cavity and crush them. Once the wood has been completely removed, a test fit can be done with the inlay piece, and any refinements to the hole can also be done at that time.



The picture above shows the inlay piece being tested for fit in the cavity. The alignment can be modified a little bit should there happen to be a hole that was cut a little off center, and the epoxy used to inlay the piece will help hide any small flaws.



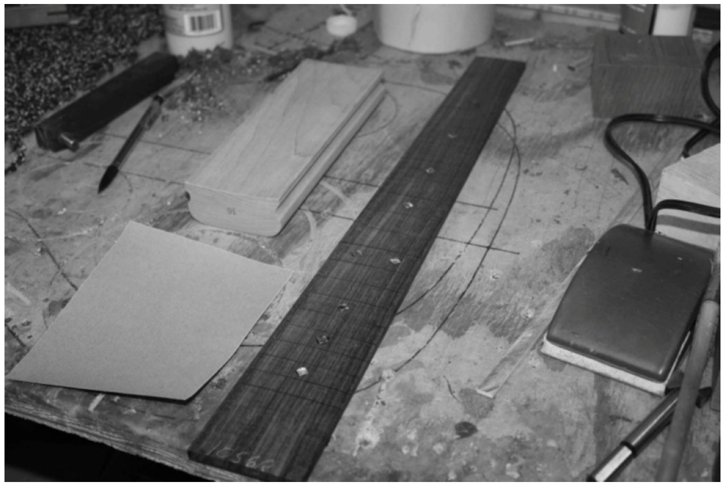
The rest of the cavities can be cut the same way, checking each one for fit before moving onto the next hole. Once the entire board has been completed and the inlays all fit, it is ready for the gluing phase.



Mix up a batch of two part epoxy on a piece of scrap wood or a couple pieces of paper. There are many two part epoxies out there to choose from, and the cheap ones are typically not as good as the name brand. Pick up a middle of the road epoxy that has at least 30 minutes of open time before it sets. Quick setting epoxy will only allow about 3-5 inlays to be done before it is too hard to use and more will need to be made. The piece will have to be left overnight anyway before it can be sanded, so do not worry about getting an epoxy that dries quickly. Any good clear epoxy will work well.

Drip some epoxy into the cavity with a toothpick or piece of purfling, making sure to coat the side walls of the hole well. Insert the inlay piece and tap it in place with the toothpick. Epoxy will flow up around the edges of the hole, and it will fill any gaps that might be there.

After the piece dries overnight, sand the inlays level with the fingerboard using a radius sanding block, and the inlays should look great with no gaps.



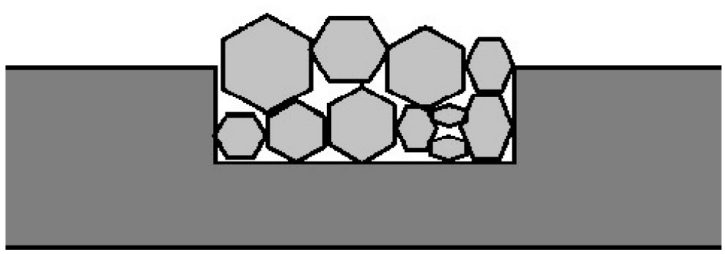
EPOXY AND STONE FRET DOTS

Colored stone can be added to a clear epoxy to create a very nice looking stone inlay. The epoxy is used as the binder to hold the rock in place, which takes on an interesting pattern once it is sanded flush.

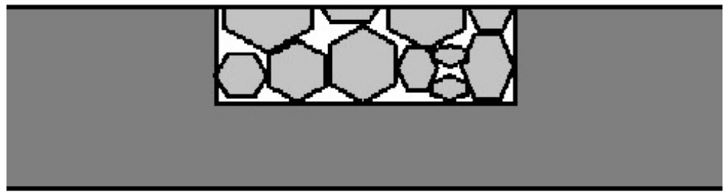
The epoxy that is needed for this kind of inlay is clear epoxy that has an open time of 30 minutes or more. This is because there will be some time needed to mix the stone into the epoxy, and get it all into the cavities before it sets up.

Avoid any epoxies that are the cheap yellowing kind, and also the quick curing variety, because there will not be enough time to work with them.

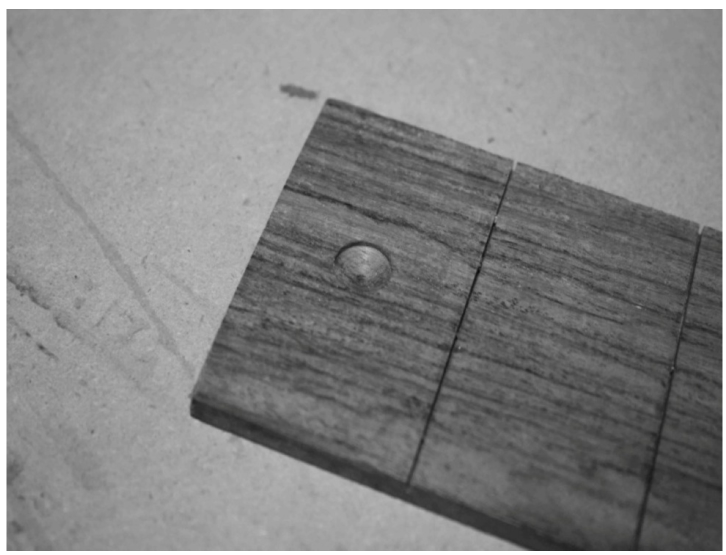
The method for this inlay will be to first create the cavities in the fretboard that the stone and epoxy mixture will go into. This can be done with a drill and a Forstner bit, making sure to keep the dots centered in the fret boxes. Once the cavities have been created, it is time to do the inlay. The way this works is a little different than a regular inlay though, which will be explained.



The above diagram shows a cross section of the fretboard, with tiny stone fragments filling up an inlay cavity. The important thing to remember when filling the cavities is to overfill them slightly. This will make sure the largest amount of rock will be cut through once the inlay is sanded level. If the cavities are not filled all the way, a very poor looking inlay will result, because the color of the stone will not show through the epoxy very well.



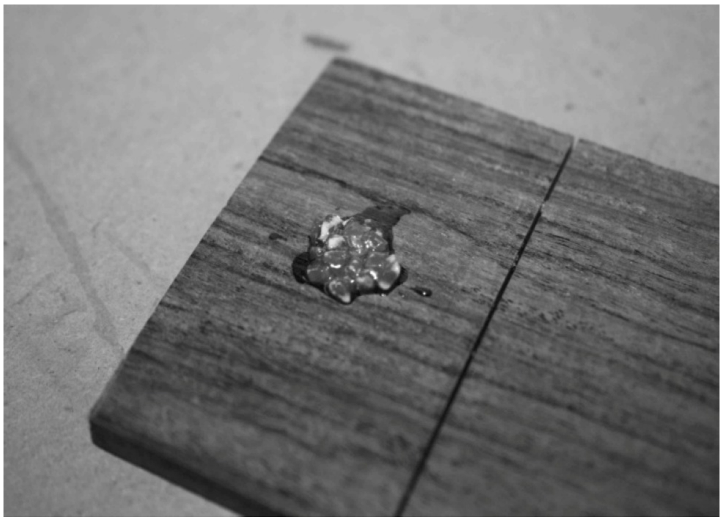
The bottom picture in the left column shows what the inlay will look like once the excess has been sanded off. The stones that are half way in and half way out of the cavity are split in half from the sanding, and their centers are exposed. This creates a nice looking pattern when viewed from the top.



The first step is to measure and mark the locations for the fret dots and drill them into the fretboard. Make them about 1/8" deep so that there is room for the large stones to get into the hole. Drill all the locations at once, and brush any sawdust off the board afterwards.

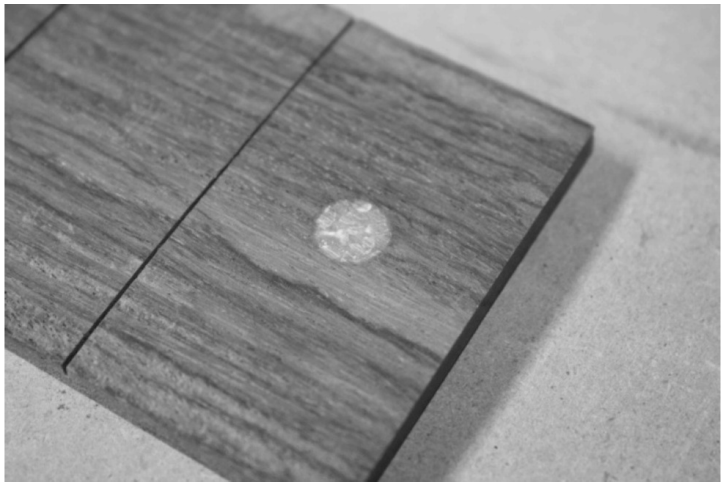
There are a couple companies that make inlay rocks, sometimes called nuggets, however almost any rock can be inlaid using epoxy. The stones from the companies that specialize in inlaying them use a softer stone material that is easier to sand through. The only difference between one kind of stone and another, is what kind of abrasive will need to be used to level the stone out after the epoxy sets. It is recommended that store bought stone specifically made for inlaying is used for the first project, because it will be much easier to work with. The In-Lace company sells these stones online, and they come in dozens of colors.

The next step is to mix the stone fragments with the epoxy on a disposable piece of scrap or a couple sheets of paper. This example is only mixed with large stone fragments, though smaller fragments can be mixed into the batch as well. Color pigments can be added, copper flakes, or metal shavings can all give an epoxy inlay a unique look.



Using a toothpick or a piece of thin purfling, fill the inlay cavity with epoxy and stone. Make sure to overfill the cavity, and that every part of the hole has something in it. Try not to get the epoxy on any other part of the fretboard because it is harder to remove than normal glue, and will not take a finish at all.

Move along the entire fretboard repeating this until every cavity is filled slightly higher than the rim of the hole. Place the fretboard in a safe place to dry overnight, and let the epoxy cure. Look on the package to see when the full strength cure is reached on the epoxy, and make sure to wait at least that long before sanding it down.



Once the inlays have cured overnight, the board can be sanded. Use a belt sander or palm sander to remove the bulk from the tops of the cavities. Be sure not to sand too deeply, otherwise a dent in the board can be made.

Once the bulk has been removed, switch to 220 grit paper and a radius sanding block to do the final leveling. The fretboard will have to be sanded a little finer than normal with epoxy, because it will show scratches from the sandpaper. Go from 220, to 320, to 400 grit and finally rub with some steel wool. Do this on the entire fretboard to ensure that it stays level for fretting.

An optional step is to polish the fretboard on a buffing wheel using abrasive compounds. This will shine up the epoxy as well as give a very smooth finish to the surface of the fretboard.

Project Notes:

The creative part of using epoxy inlays is that there are practically no limits to what can be put into the mixture. Companies sell a wide range of materials specifically designed to go into epoxy, however there are dozens of items right in the shop that would make interesting looking inlays.

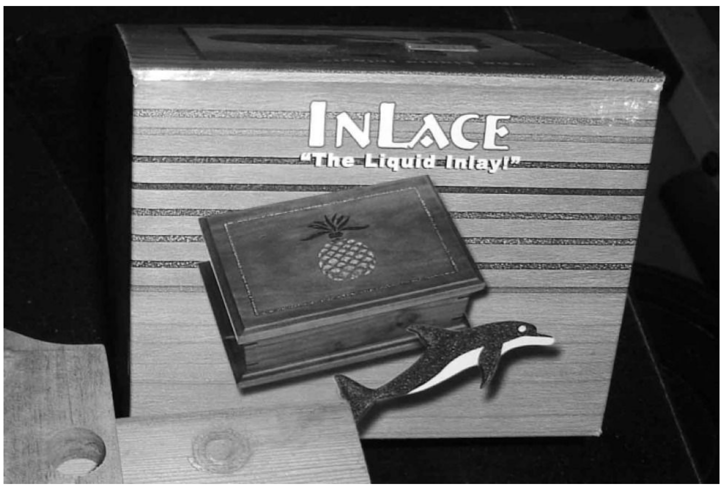
Pick up some epoxy and experiment with different looks and inlay recipes. Try mixing large stone fragments of one color with smaller fragments of another. Turquoise can be copied by mixing large and small turquoise stones together with some black dust. Try adding a very small

amount of copper flakes to this mixture, and it will add some sparkle in a few places.

Epoxy can be colored using pigments for paint, or used clear. Lightly tinting the epoxy can have a nice effect with similar colored stones, though too much will make the epoxy opaque. Try red pigment with black stones for an interesting color combination.

INLACE SIDE DOTS

The InLace product is a very creative way to get into inlay work, and is far easier than the standard inlay process. The benefit of using InLace is that only the cavity needs to be cut correctly, and not the actual inlay piece. The liquid epoxy will in essence become the inlay piece, and it will conform to and fill any cavity that is made for it. As long as the cavity is right, the inlay will look great.



In this example, the guitar being embellished is an acoustic bass, and the side dots are going to be done with InLace instead of small plastic dots. Also, the InLace dots themselves are going to be made a little larger than normal, which will show them off more. This is a simple way of incorporating an epoxy inlay while not going overboard. Since the method of installation is essentially the same as the standard side dots, there should really be no issues with making these inlays work.

The first part of the preparation of the neck requires that a drill size be chosen, that will make the cavities for the InLace. Depending on personal preference this can be a larger bit size like in this example, or a smaller one. Either way, select a brad point or Forstner bit of the appropriate size and chuck it in the drill press or hand drill.

Mark out the locations for the dots, which are usually on frets 1,3,5,7,9,12,15,17,19, and 21. Using a small ruler with a fine graduation, find the center of each fret, and place a mark for drilling. Typically, fret dots are very small, and they are centered inside the fretboard material. In this

case however, since they are so large, they are centered right on the place where the neck is glued to the fretboard. This gives a second line so to speak, where the intersection with the center line will be drilled.

When all the dot locations have been marked, go back and drill them carefully, making sure to avoid any chip out, and drill only about 1/8" below the surface of the wood. Any farther is not necessary, because the inlay is opaque, and cannot be seen through. This depth is plenty for getting enough InLace into position to dry well and harden into a great looking inlay.

Mix up a small batch of InLace according to the instructions found on the package, and remember to only mix what is needed. When the hardener is added and the epoxy begins to firm up, any excess that is not used will have to be thrown away. It cannot be added back into the rest of the can, because it will cause it all to harden prematurely.

Use the small cups that are provided with the InLace product in order to mix a small batch together. Immediately bring it over to the guitar to begin using it before it has a chance to harden, which will happen in several minutes.

Using a toothpick, a piece of purfling, or other small piece of scrap, drip some InLace into each hole, filling it up slightly taller than the surrounding wood. Do not fill it so much that it runs out and gets into places it should not, though make sure that it is filled a little higher than level.

Later on the excess will be sanded off, leaving a level surface, which means that right now there needs to be extra added to ensure a good fit later. Go from hole to hole, completely filling one before moving on to the next. Be sure there are no air bubbles in the holes by poking the toothpick or purfling into the center after it has been filled. This will hit any larger air bubbles and force them to be expelled from the top.

When every hole has been filled, put the piece in an area where it will be undisturbed overnight, which will give the epoxy plenty of time to cure.

When the epoxy has dried, begin removing the excess that was filled over the top of the hole with sandpaper. A piece of 150 will remove the excess waste very quickly, and once close to level, it can be finalized with a piece of 220. This material will sand, scrape, and work just like any other epoxy, and it is very easy to sand down level with the surrounding wood.

After all the inlays have been sanded flush, the final sanding and finishing of the neck can happen just like normal. The InLace will work fine under any finish, and it even looks great under Tru-Oil, because it forms a nice top layer. The InLace color used here is Lacey, which will require the imagination to envision, but it looks similar to turquoise.

CUSTOM INLAY PATTERNS

When inlaying stone or other materials into a cavity as in the above example, the possible inlay shapes are endless. Since the inlay cavity will determine the shape if the work, and actual inlay pieces do not need to be cut to fit, very elaborate patterns can be created easily.

An excellent source for these patterns are scroll saw books, which transfer easily to this kind of inlay style. Patterns can also be made on the computer from any photo as well. This is where inlaying gets really personal and exciting.

For example, the above picture shows a custom inlay pattern of me wearing a cowboy hat on a camping trip. This can easily be traced onto a piece of wood like a guitar back, and a cavity cut out with a Dremel or router. The white parts of the image would be the areas cut out, and an epoxy and stone mixture would be filled in.

Here is the original image for the custom inlay pattern created on the computer. This is a very simple process for anyone who has any computing experience, but it should not be too hard follow along in any case. The program does most of the work at creating a black and white version of the picture, then the image is smoothed out by hand.

The program that will be used for this project is called Pixlr. It is a cloud based free program that does not require any downloading or registration to use. Go online and type www.pixlr.com into the address bar, and the site will open. From there, click on "Open Pixlr Editor (Advanced)", and the program will start.

When the program is launched, the first box that will appear is the one above. There are several options to using Pixlr, and the program just wants to know what to do when it opens.

Creating a new image will start the program from scratch on a white background, and every single element will need to be done by hand. Since we are working with an existing picture, this is not our option.

The second option that says "Open Image From Computer" is the option that will allow a picture to be opened through Pixlr, that is saved on the computer. This is how the picture will be opened and edited, so click on the second option.

It is helpful before starting this process to save a couple images to play around with on the computer desktop, or in another file that is easy to find. This way, it is very easy to open up and try different pictures with this technique.

Some pictures work better than others when it comes to this process, and unfortunately it is hard to say why until the photo is loaded and

tried out. Most will work however, and it is a very quick process to see if a picture will or will not work.

Follow the prompts after selecting "Open Image From Computer," and select the image to be turned into an inlay pattern. The image will open on the screen like in the above picture.

The first thing that needs to be done, is the image needs to be cropped down to a size that can be used for making the inlay. This picture was meant to be used for the image of the face, so it needs to be reduced to only that portion.

Cropping is a photo editing term that means cutting out a certain sized section of picture from the existing image. In our example, we are going to crop, or cut out my head and hat only, getting rid of everything else.

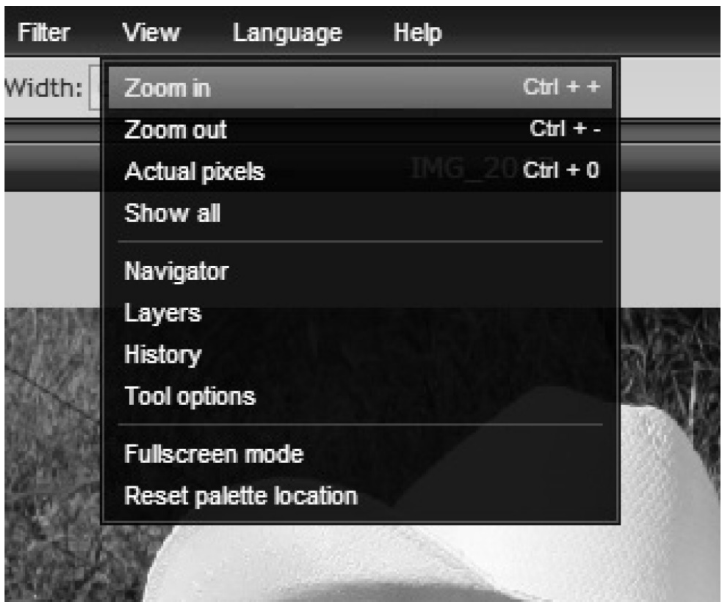
Click on the "Crop" tool on the left side of the screen, and this will allow the mouse clicker to make a selection to crop the image that is open.

Click a little above and to the left of the part of the image to be saved and hold down the mouse button. Drag the mouse down and to the right, creating a box around the area to keep, never letting go of the mouse button until the box is made. If the box is in the wrong place, it can be moved around with the mouse, and re-sized by dragging the corners to make it larger or smaller.

Click and hold the box by the center and drag the mouse to move it around. If the box is too big or small, grab any of the corners of the box with the mouse, and it can be made larger or smaller by clicking and dragging as well.

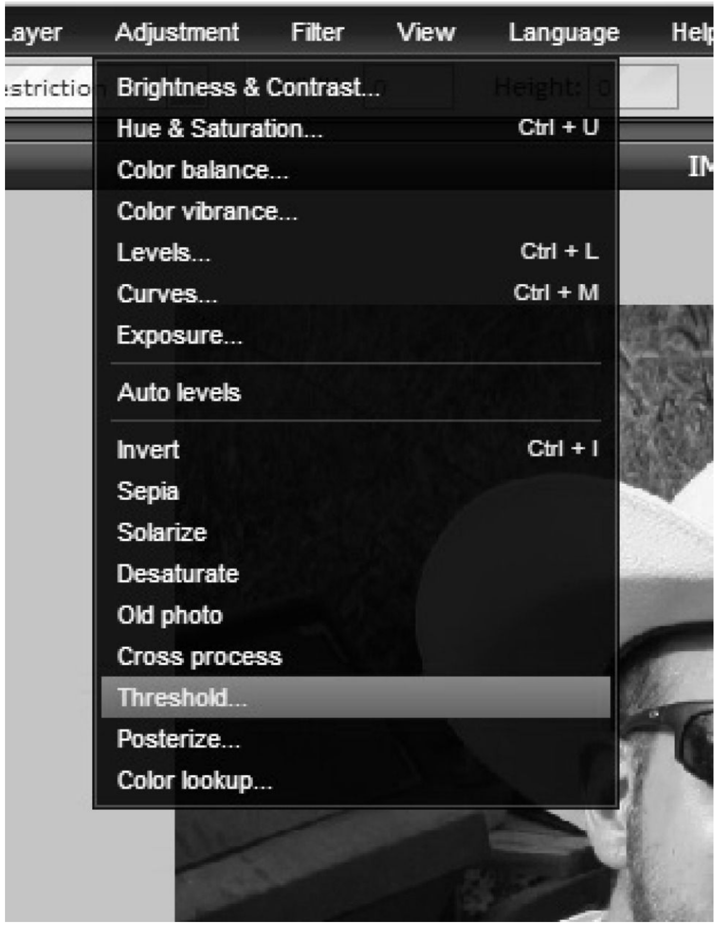
Once the selection is made, and any resizing has been done, click on the crop button on the top left hand side of the screen, to actually cut the picture down to size. Any part of the picture not inside the box will fall off, and all that will remain is the part of the picture selected.

The program will ask if it is alright to apply the changes, and click "yes." Once this happens the crop will be completed, and the selected pixels will remain behind. If this comes out terribly, click "Edit" from the top left hand side, and then "Undo," and it will bring back the original image. The crop can be tried again as many times as needed until it is correct.



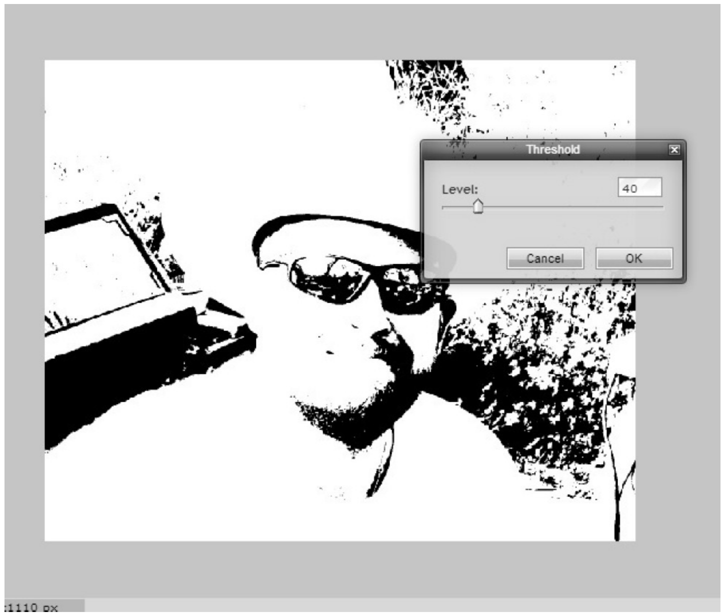
Depending on how small the cropped image was in comparison to the original image, the remaining section may be very small and hard to see. Click on "View" from the menu along the top, and then "zoom in." This will make the picture bigger. It may be clicked on several times, however do not make the picture bigger than the window size it is being viewed in. If the image is zoomed in too far, just click "view," then "zoom out" to move it back.

The mouse wheel will also zoom the image in and out by rolling the wheel forward to move it away, and backwards to move it closer.

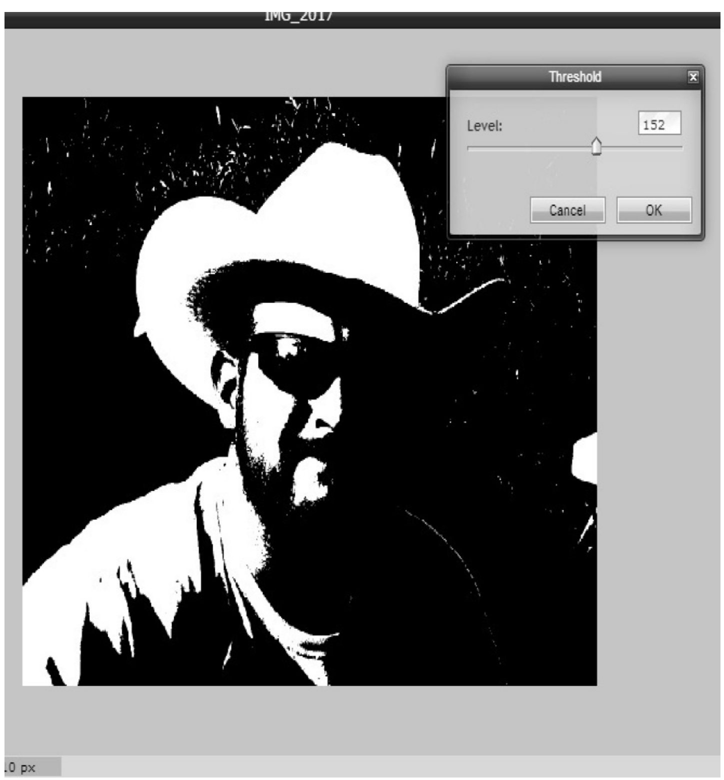


Now that the image has been loaded, and sized for the application, the real business of creating the inlay pattern can begin.

Click on the "Adjustments" selection from the top menu, and then go down to "Threshold" and click on it.



The image will be instantly converted to a black and white version, with a dialog box and a slider that will adjust the level at which the effect will be applied. Play around with this slider, moving it to the right to increase the effect, and to the left to reduce it.



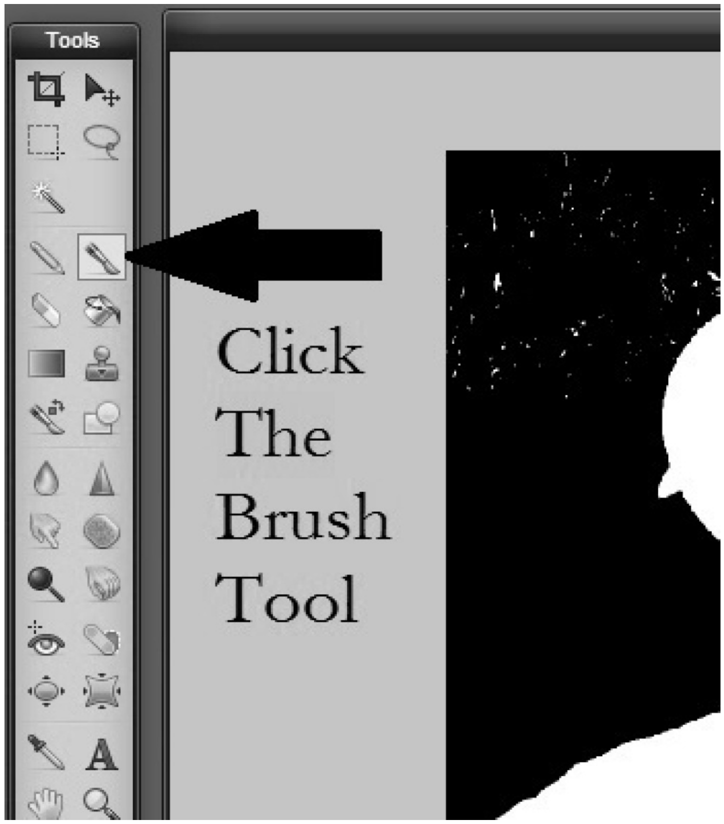
This is where playing around with the image will teach much more than a tutorial will. The purpose of changing how much the threshold effect is applied, is to get the image to the point where it could be traced over as an inlay. The white parts are the cavities to be cut out, and they need to be adjusted to the point where there are less of them than the black background.

Looking at the previous picture where the threshold was initially applied, there is way too much white to be able to use that image. Plus, it really does not look anything like me if I were a black and white cartoon drawing.

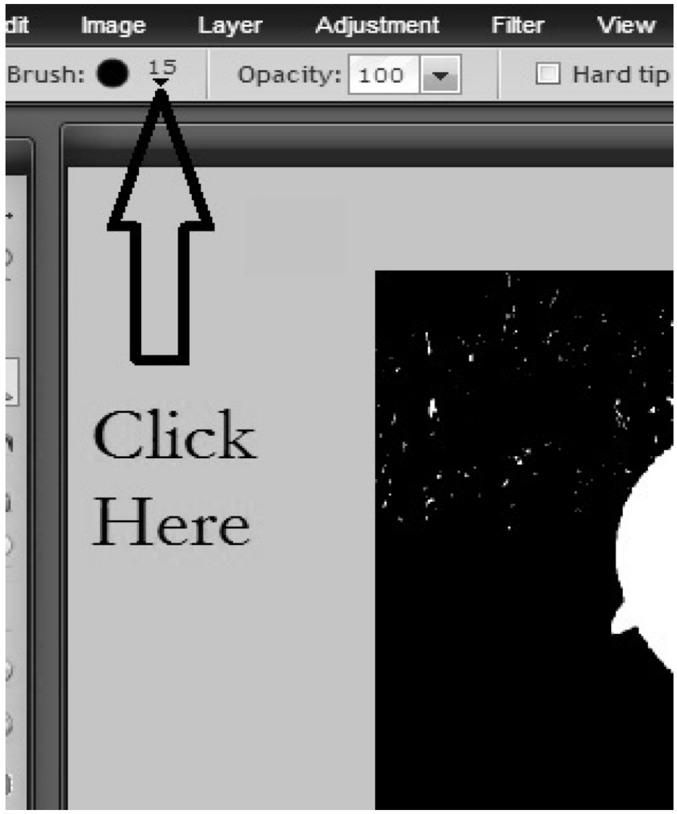
The second image showing the threshold adjustment is a better candidate to create the inlay cavity from, because it has less white sections and also shows a better looking depiction of my face.

Adjust the intensity up and down on the slider until it is very blotchy but still looks like the original image enough that it will be recognized. This will take a little getting used to in order to know when a picture has been adjusted well enough to complete the next few steps with. A small recommendation is to not let the image get too detailed, because it will require lots of touch ups later on before it can be used as an inlay. This will all become very clear once the rest of the steps are performed.

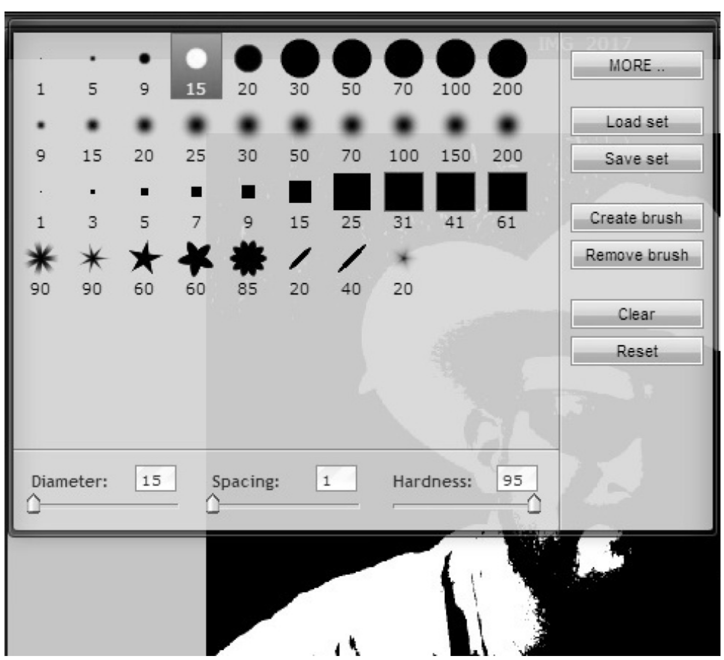
The next steps will deal with all the clutter and the black and white dots all over the place, since these cannot be eliminated with the threshold adjustment. The best way to eliminate these is to use a freehand drawing tool that will allow black and white areas to be filled in by hand, polishing up the pattern.



The brush tool is the best option for this kind of filling in, and can be found in the tools section on the left hand side of the screen. This tool is literally what it sounds like, and will allow the user to paint on the image with the mouse.



The size and the type of brush tip can be selected and changed by clicking on the part of the screen indicated above by the arrow.



When the brush options are clicked on, this box will pop up, allowing the brush type and size to be changed. It is a good idea for this project to use a hard brush (top row) and select a size that will cover well but not be too hard to control.

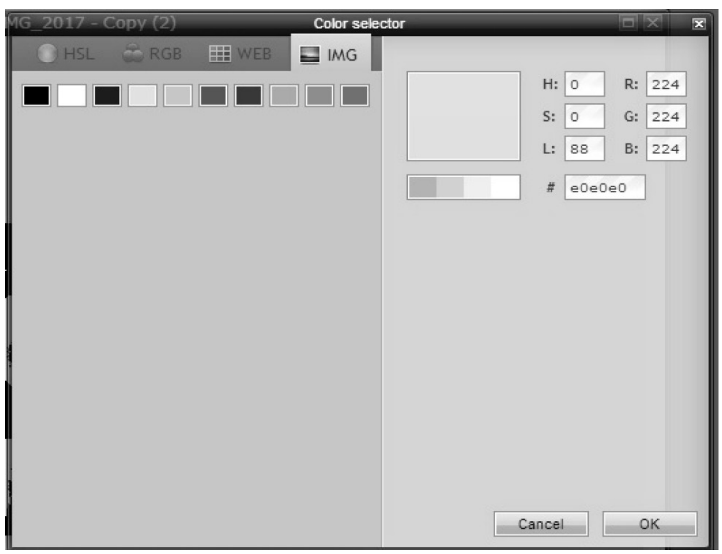
Selecting a very large brush, the background can be painted over with black very easily and quickly, without painstakingly going over every little speck of white left behind. Using a smaller brush, details in the face can be worked out, while not destroying the basic image made with the threshold adjustment.

Zoom in and out if necessary to get an easier look at where the image is being painted, and fill in all the black areas until they are solid.

Once the brush is selected, click off of the box somewhere or on the image itself in a black area to close the brush tip selection box.

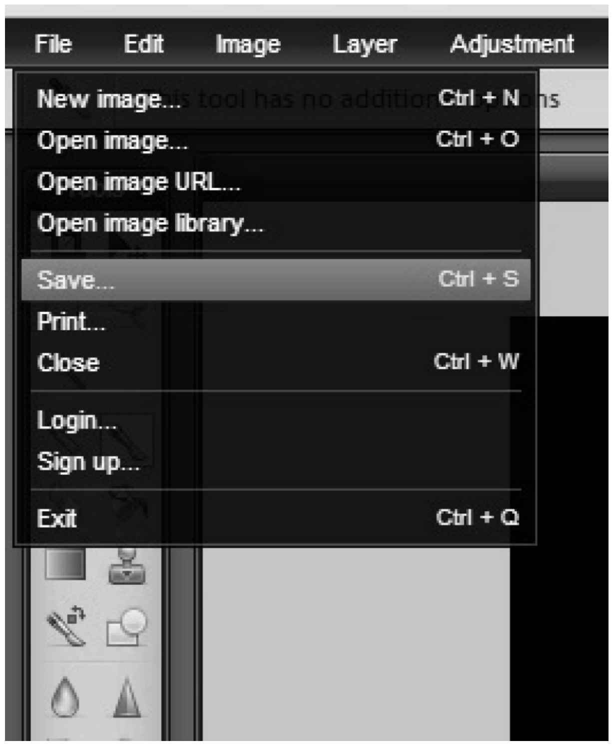
The bottom left hand image shows the picture mostly completed, with a few little areas that still need to be filled in. This looks very much like the original image, and would make a nice looking inlay.

If a white area needs to be filled in, which will happen once all the black areas have been filled, click on the color selection tool on the lower left hand side of the screen.

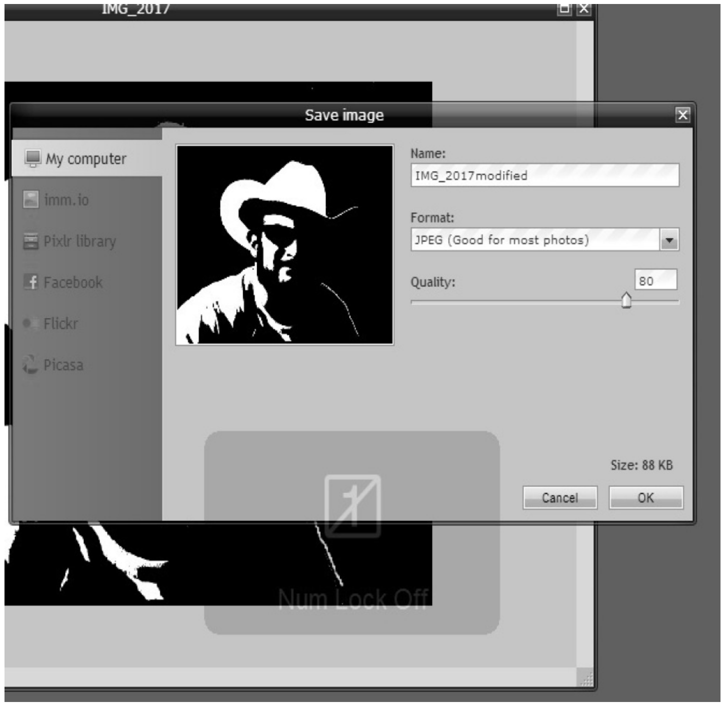


This will bring up a box where the color of the paint brush tip can be changed. Click on the tab along the top that says "IMG" to get the computer to look like the above picture, and from there it will be very easy to select a white box with the mouse, changing the paintbrush color to white.

If this needs to be changed back to black again for some other touch ups, simply open the color selection box again by clicking on the lower left from the tools menu. The change can be made, and then it is back to painting until all the shapes are smooth, and they look like they could be cut easily with a router or Dremel tool.



Once the image is finished, it needs to be saved so that it can be used when needed. Click on "File" from the menu along the top of the screen, then click on "Save."



The saving box will open, allowing the picture to be named and saved. Change the name of the file by clicking in the top box where it says name, and typing in a name for it. Do not just save it as-is because it will replace the original file with this new one, making it impossible to get back. Also, slide the "Quality" slider all the way to the right so that the highest quality of picture is saved.

Once the new name is selected and the quality maximized, click "OK," and it will allow the choice of where to save the file. Save it where it will be easy to find again, like the desktop or in the same file folder that the original pictures were in.

Here is another example of using the threshold adjustment to make an inlay pattern. The above picture is my old dog Gohan, and the inlay is below.

Once the file has been saved on the computer, open it using a word processing program like Google Docs or MS Word. Drag the corners of the image until it is big enough, and then print it out on regular paper. If it needs to be bigger or smaller, make those changes and print it again.

To actually use the template, stick it to the surface where it will be inlaid using a thin coating of glue. Using a router or Dremel, cut a shallow cavity following around all the white sections until they have all been removed. Sand off the rest of the paper, and fill with an epoxy and

stone mixture. Once dry, sand it level and it will be an excellent looking inlay.

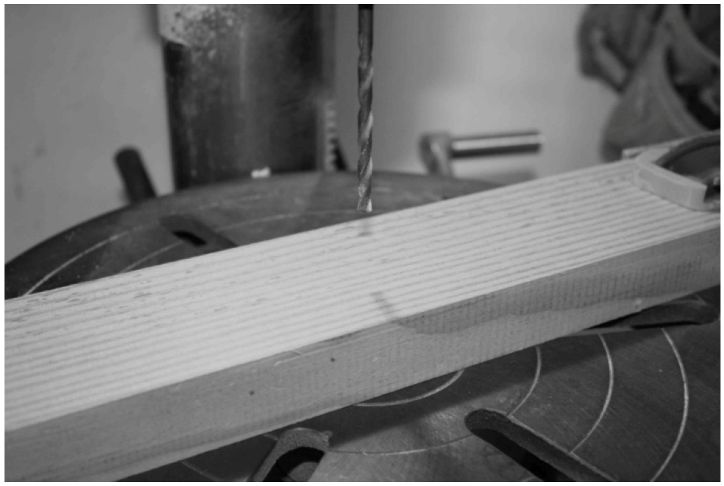
There are much more detailed instructions earlier in the chapter on how to make an epoxy and stone inlay.

BRASS BRIDGE PIN INLAYS

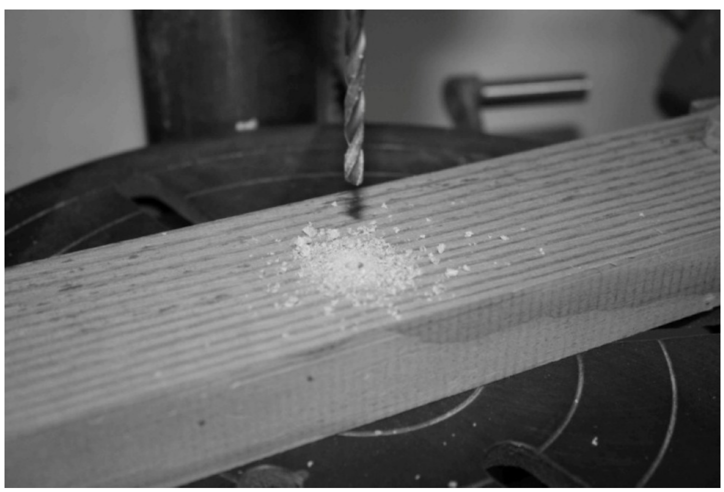
Inlaid bridge pins are a nice looking touch on any guitar, and help draw the eye to the bridge. The inlays can be made from plastic, abalone, mother of pearl, or in this case brass. The process is very easy on a drill press, but could be done with a hand drill as well.

This process is best done on a drill press, and is how the instructions are written here. A drill press makes a very straight and accurate hole, which will help to keep the dots centered on the heads of the bridge pins.

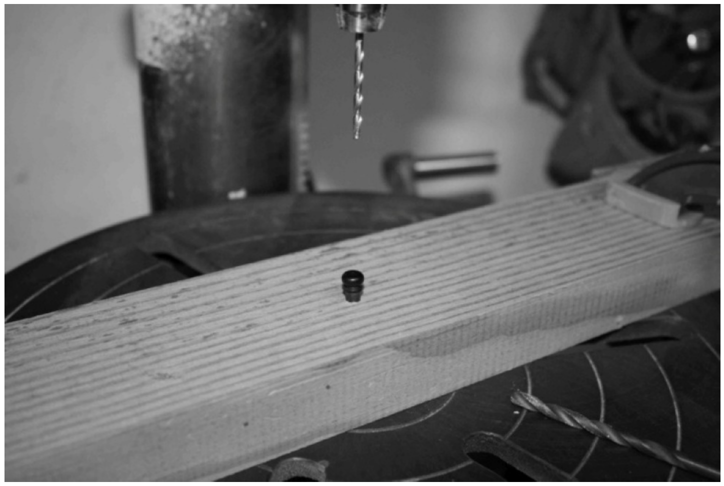
If a hand drill is going to be used, make the pin holder the same way as described, then mark the centers of the pins with an awl before drilling them. This will give the bit a mark to follow, helping to drill accurately in the center of the pin.



On the drill press, clamp a piece of wood across the table top. This piece of wood needs to be thicker than the height of a bridge pin, because it will be used as a holder. Once the piece is locked into position, check the bridge pin against the side to ensure that it is tall enough. Chuck a 3/16" drill bit and make sure the wood is under it.



Drill a hole with the 3/16" bit all the way through the piece of wood, and clear away all the sawdust created.



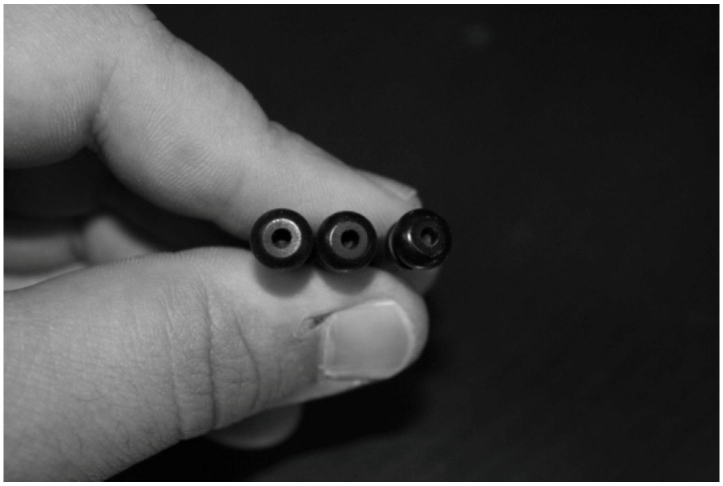
Switch drill bits to a smaller diameter bit, that matches the inlay size. In this case a brass rod from a hardware store that is 3/32" in diameter is going to be inlaid, making the drill bit a 3/32". This brass rod can be found at smaller hardware stores or online, and it comes in 12" lengths.

Insert a bridge pin into the 3/16" hole and press it firmly into place. This hole is used as the holder for the pin while drilling the smaller inlay hole, and it is important not to move the wooden piece at all during drilling. The bridge pins are standard store bought ebony or rosewood pins, without any inlay on them.

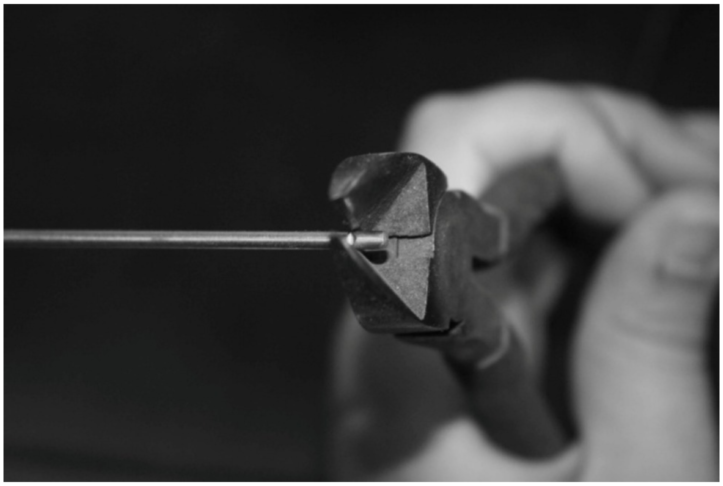
Check how the new drill bit lines up, and drill a shallow center hole on the top of the bridge pin. Do not go very deep because the drill will

punch through where the string slot is, and that area needs to remain clear. Drill in approximately 1/8" or slightly more, then back out the drill.

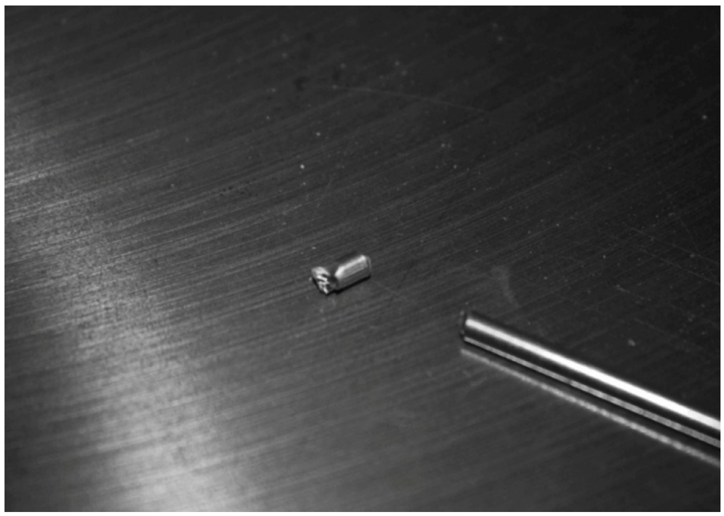
The secret to the easy operation of this drilling method, is that the drill press always wants to drill in the same place no matter what size drill bit is being used. The larger drill makes the hole to hold the bridge pin, and the smaller bit hits the center of the pin every time, because nothing has been moved on the drill press table.



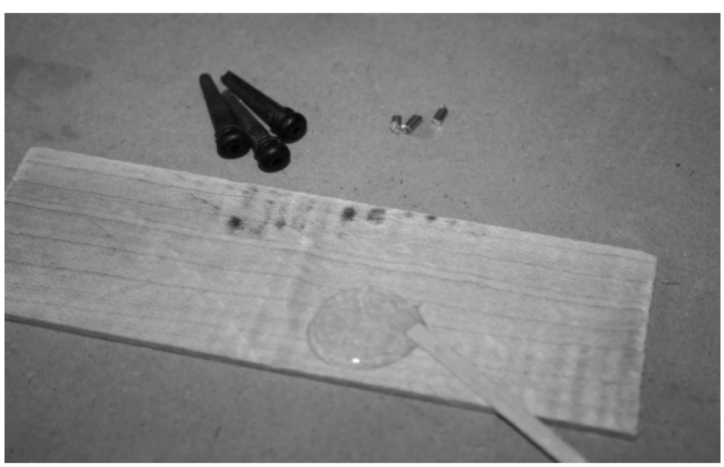
Drill the remainder of the pins the same way as the first one, making sure not to move the piece of wood. Pull out the drilled pins and insert new pins to be drilled until every pin has a hole in the top for an inlay.



Carefully cut the brass rod into small pieces that will be inlaid into the bridge pins. This is best done with a wire cutter or a hack saw. The wire cutter will rocket the freshly cut pieces across the shop if not careful, and they will never be found again. Only cut these pieces about 1/4" long, which is just enough for a pliers to grip one end and shove the other into the bridge pin.

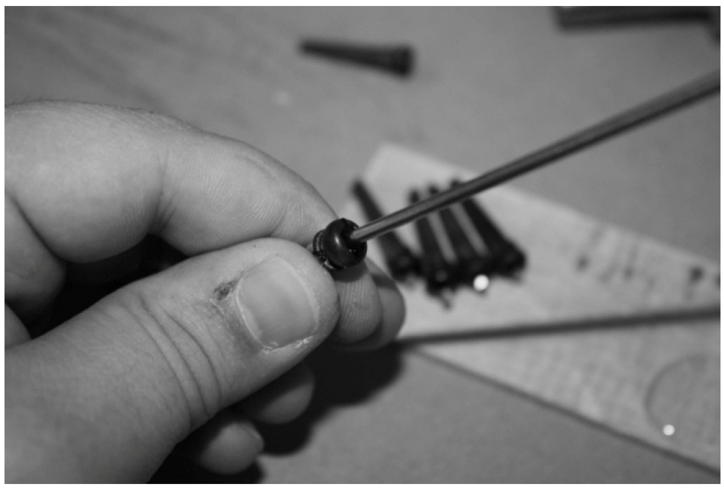


If cutting them with a pair of wire cutters, make a cut about half way through then rotate the piece 90 degrees and cut the rest of the way on the fresh sides. The reason for this can be seen in the above picture. Cutting all the way through on one side mashes the soft brass and makes it hard to get into the small inlay hole on the bridge pin. Cut them carefully and cleanly, and they will be far easier to get into the pins.



The next step is to mix up some two part epoxy and set the brass pieces into the ends of the pins. A small piece of veneer or a toothpick makes a great glue dropper, and helps get the epoxy down into the hole in the bridge pin.

Use the toothpick to drip epoxy into the hole, then using a pliers, force the small piece of brass into the hole. Twisting it as it goes in helps get an even coating of epoxy all around the brass, which is needed to make it adhere well.



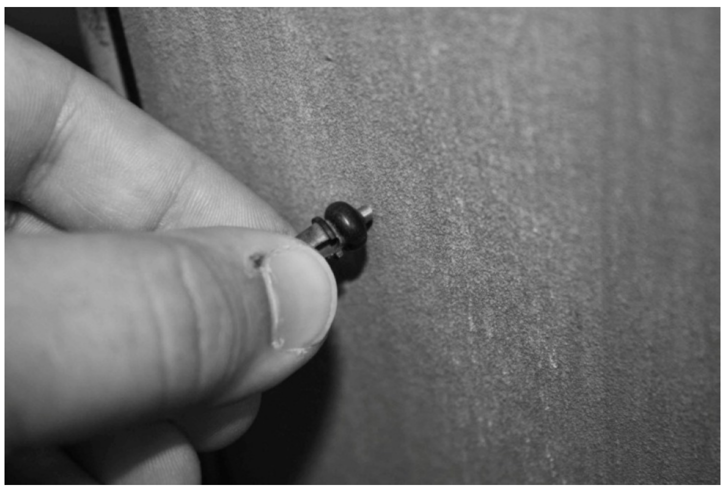
Another way the brass rod can be glued in place is by dripping in the epoxy and then inserting the end of the rod into the hole. It is then clipped off immediately with a set of wire cutters, and the process is repeated. The pliers method works well, but sometimes it is easier to use the entire rod for leverage while pressing it into the hole in the bridge pin. Also, pressing the rod into the pin allows for a closer cut with the pliers, which will conserve materials. Though the brass rod is not very expensive, getting more mileage from a piece of material is never a bad thing.

Repeat the procedure until all of the pins have their brass piece glued in place. While the epoxy is still wet, wipe off any that may have gotten on any other parts of the bridge pins. Epoxy is a very difficult adhesive to remove once it has set, so taking the time to wipe it off now will save much more time later.

Check that the holes have not been drilled completely through the head of the bridge pin, getting into the string clearance groove. If this has happened, use the toothpick or the brass rod to push the inlay up a little to keep this area clear. Wipe off any excess epoxy from the pin after pushing the inlay out of the way. Check all the pins like this, and clean them up well before they dry.

Once all the pins have been inlaid, make a small stand for them to dry in from a piece of scrap wood. Drill six holes in the top with the 3/16" bit, and insert a pin into each one. This will keep the epoxy on the top of the bridge pin where it cannot get into places it should not. Also, the chance that the pins will glue themselves to the workbench is reduced, because the epoxy will not be able to pour out.

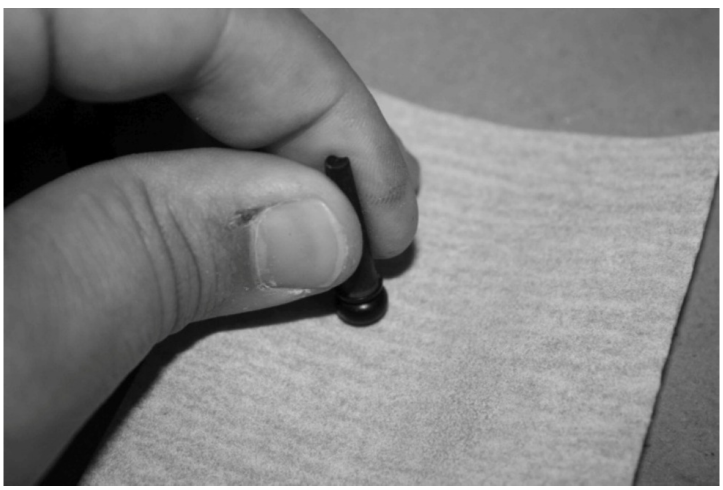
Leave the pins to dry for several hours, or according to the instructions on the epoxy being used for the project. Once they are fully cured, it is safe to proceed to the next few steps.



Once the pieces have dried, the bulk of the brass rod stock can be removed by using a belt sander or a palm sander with 120 grit paper. When using a power tool to remove the excess brass, it is important not to let the brass get too hot. Holding the piece against the belt creates friction, which removes the material and also raises its temperature. The brass can easily get hot enough to break the bond of the epoxy, which is not what we are after.

Press the piece against the sander for a second, then remove it and blow on it. Placing it against a piece of cold metal like a table saw top will also help cool it. Repeat this until the bulk of the material is removed.

The bridge pin should now look something like the above picture, with the majority of the material sanded off, and only a little epoxy remaining around it.



Switch to 220 grit sandpaper, and work the head of the bridge pin in circles until the brass is flush with the wood, and the epoxy around the edges of the inlay is gone. Do not press too hard, otherwise there will be sanding marks left behind that will be difficult to remove.

Switch to 320 grit paper, making the same circular motions, removing the scratches left by the 220 grit.

Use a buffing wheel and tripoli compound to smooth out the marks made by the 320 grit paper. If a buffing wheel is not available, sand the top of the bridge pins with 400 grit, then 600 grit paper, and they should look pretty smooth.

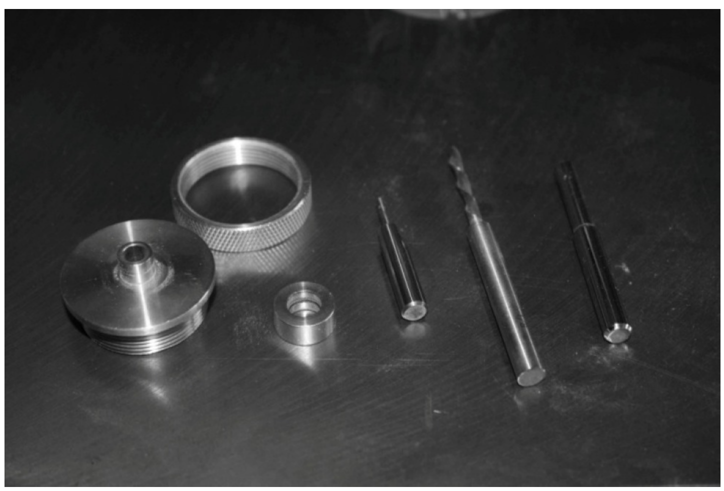
The bridge pin should now look like the above picture, with a very shiny head and a polished look to the brass.

The finished bridge pins are now ready to be used, and will add beauty and value to any guitar they are installed on.

ROUTER INLAY GUIDE

Inlaying is a completely separate skill from guitar making, and requires as much time, talent, and dedication to become good at it. A guitar maker has to learn at least a few inlay techniques in order to make their guitars look consistent with professionally made instruments. Fret dots, soundhole rosettes, and end flash are all technically inlay work, though it is the more interesting and artistic inlays that get all the credit.

When it comes to more elaborate inlays there are an entirely new set of skills to learn, and a large amount of patience needed to work with tolerances that are so small. For basic inlays however, an inlay kit for the router can be very helpful.



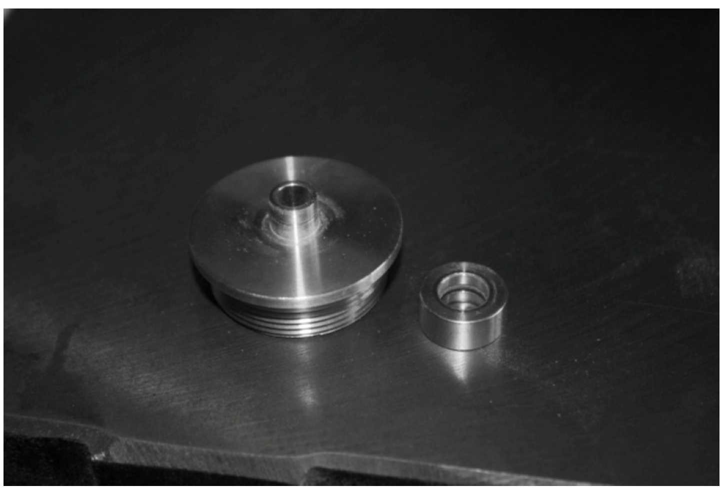
An inlay kit for the router is a special bushing and bit set that lets the router cut a cavity for an inlay following a template, and then the inlay itself from the same template. It performs the best on larger inlays without an incredible amount of detail, because it is limited by the bushing being able to travel around the template.

The way it works is by having a small brass collar that is removable, and it changes the distance from the template that the bit cuts at. The cut changes position by exactly the same width as the bit being used to

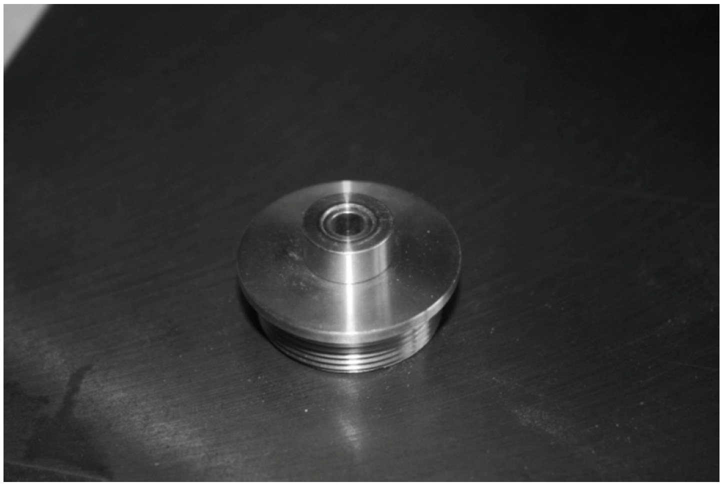
cut with, making two pieces that fit together. Here is a brief rundown of what the procedure will look like.

The bushing is installed on the router, and a carbide cutter is locked in the collet. The pre-made template is clamped on top of the wood that will be inlaid, and positioned where the inlay will be. With the bushing and the brass collar in place, the router follows the template, removing about 1/8" deep of material. Then the router is used to remove the rest of the material inside the template, creating a large cavity in the same shape.

After the negative or cavity is created, the positive or inlay piece needs to me made. The brass collar comes off the bushing, and the template is clamped onto a different piece of wood that the inlay will be cut from. The router is used again to carefully follow the outline of the template, this time only cutting around the edges. When the piece is removed, it will fit into the cavity that was made in the previous step. These two steps together can be repeated with any template and on any type of wood.

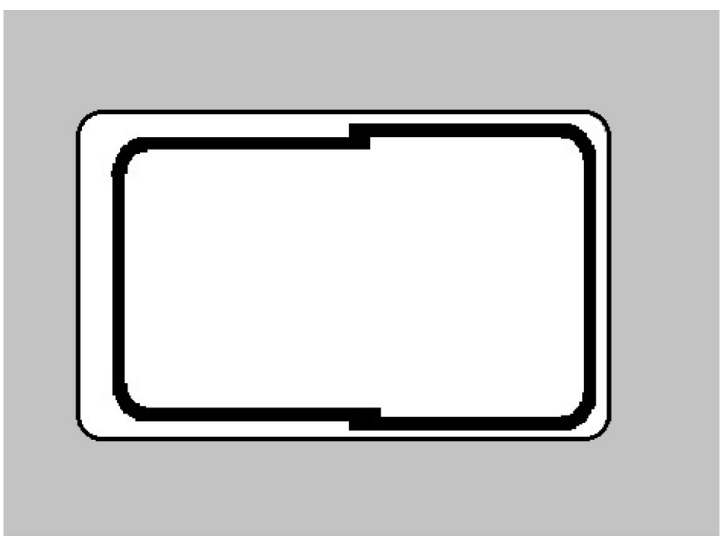


The bushing for the router in the above picture is on the left and the brass collar on the right. The bushing fits into a small indentation on the bottom side of most routers.



This picture shows the bushing with the brass collar in place, changing how close to the template the router bit can go. This change is exactly the same size as the width of the carbide cutter. In the previous picture, the small collar on the bushing allowed the cutter to get closer to the edges of the template, however in this picture that distance has been increased.

The way this works on a template is the secret to making two pieces that fit inside each other very well.

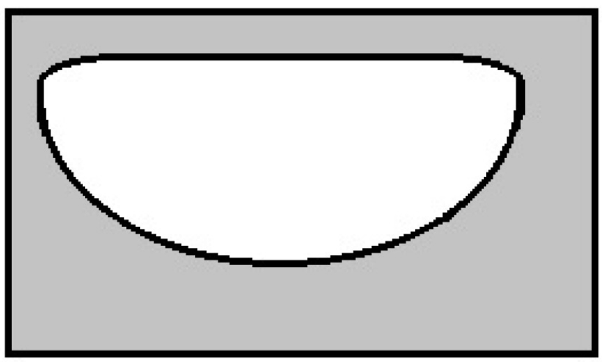


The diagram above shows an example of a template, which is nothing more than a hole cut into a piece of thin MDF. These can be made

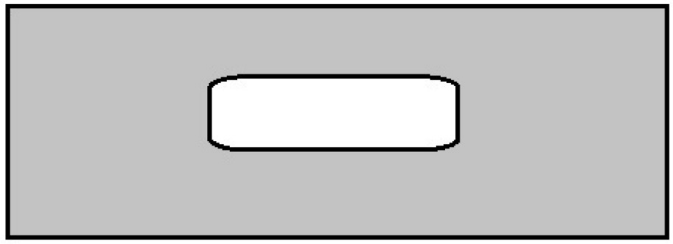
in virtually any shape needed, and are only limited by the size of the brass collar on the bushing.

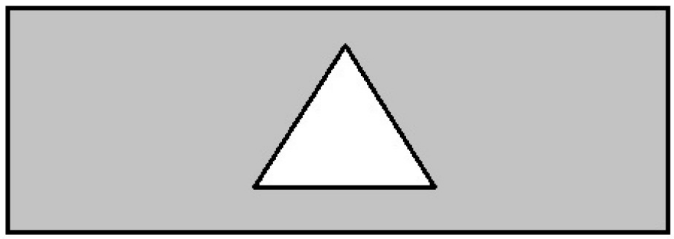
The gray in the diagram is the MDF, and the white rectangle is the shape of the template. The two black lines show the two paths that the router inlay kit will take. The path on the left is with the brass collar in place, and the path on the right is without it.

Notice how the left path is further away from the edges of the template because of the brass collar. Also, the path on the right is closer to the template because the collar is not there. The most important thing to notice however is that where the paths cross, they do not overlap. They simply are so close to each other that there is no way to see a gap between them. The secret to the way the inlay guide works is where those two lines cross.



The only other thing needed besides the router inlay kit are the templates. These can be made from any piece of thin wood or MDF, and they represent the shape that the router will inlay. The above diagram shows a template for a rear side electronics cover on an electric guitar. With this template, a perfectly inlaid cover can be made to conceal the control pots and the wiring.





Other easy inlay shapes are simple rectangles or triangles. These both make very easy and attractive fretboard inlays, and for the upper frets can be made fairly large.

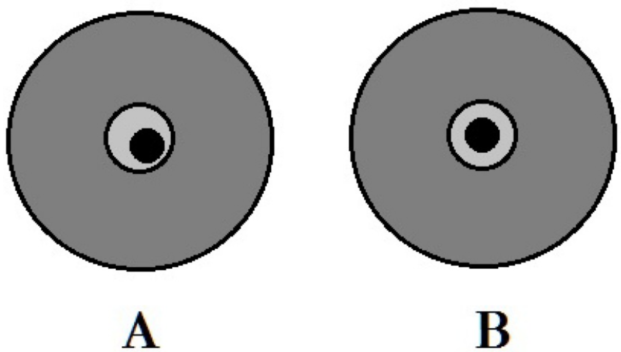
The picture above shows the rear side of an electric bass body, with the control cavity cover in place. The fit between the two pieces is absolutely perfect, and there is no gap visible on any side. This was made using a template of the same shape, and the router inlay kit.

The next section will deal with how to create templates for the router inlay kit, as well as how to set up the router so that the kit works as

well as it should. The inlay kit can also be used for more interesting inlays like larger curved shapes and bigger inlays, or for simple solid shapes. Electronics covers, fretboard inlays, and many other inlays are made easier by using a template and a jig.

CENTERING THE INLAY BUSHING

In order for the inlay kit to be effective, the bushing must be lined up correctly. This means that the carbide cutter must be in the exact center of the hole in the bushing. If it is out of center by even a small margin, the resulting cavity and inlay piece will not match. This will result in a little or a lot of sanding on the edges of the inlay piece to get it into the cavity. Also, since the cavity will be wrong too, there will most likely be gaps in the inlay that are easily visible.



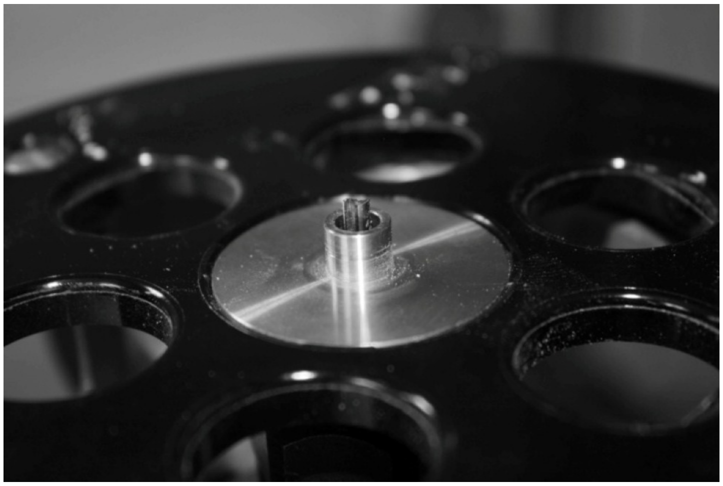
This diagram shows what it means by having the cutter aligned in the center of the bushing. The black dot in the center represents the carbide cutter, and as seen in example A, it is not in the center of the bushing. Example B is what it should look like after setting it up correctly, with the cutter in the exact center of the bushing. Diagram B will make perfect inlays, and diagram A will not.

To get the router correctly set up for doing inlay work, insert the centering pin that comes with the kit into the collet of the router and tighten it like any normal router bit. This piece will be used to accurately line up the router plate and bushing.

Loosen the screws on the router plate, but do not remove them all the way. They only need to be loose enough to allow the base to move a little.

Press the bushing into the router plate and screw on the retaining ring from the bottom. The pin should be through the center of the bushing as seen in the above picture. With the bushing screwed tightly on, and the centering pin tightly held in the router collet, tighten the screws on the router plate.

What this does is allow the router plate to move a little as the bushing goes over the center pin and into its recess. The small move makes the plate, bushing, collet, and router bit perfectly concentric, which will result in perfect inlays.



Remove the centering pin from the router collet and insert the carbide cutter that comes with the kit. Look at how it fits in the center of the bushing and verify that it also sits in the center. As long as the screws were tightened down enough earlier, nothing should have moved, and the router at this point will be ready to work with.

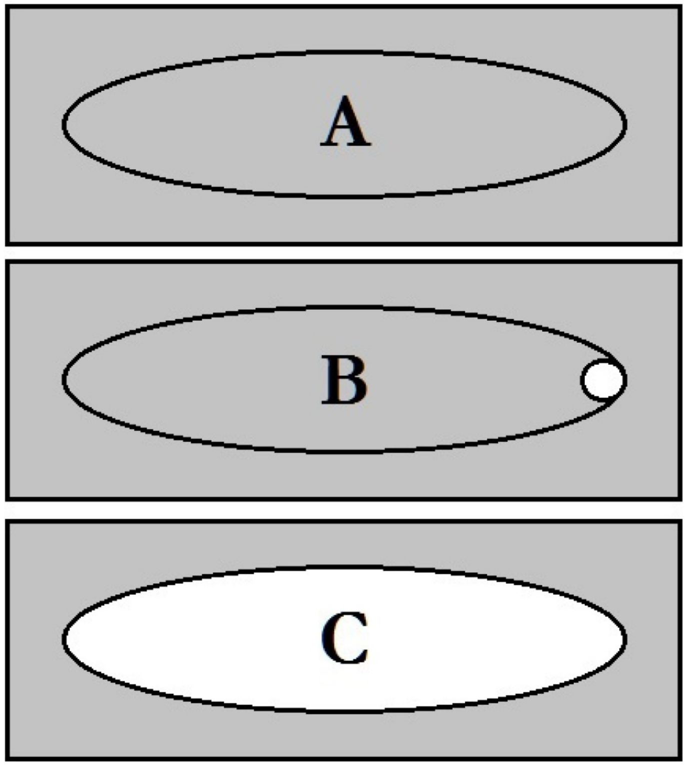
Each time the router is used for inlaying, it is worth the few minutes it takes to center the plate first.

MAKING THE TEMPLATE

The template is what determines the shape and size of the inlay, and must be made well in order to function properly. Templates can be made from any piece of wood that is thicker than the guide on the bushing, and wide enough to be clamped down to the piece of wood being inlaid. A larger template is easier to work with than a smaller one, because it can be clamped easier. Double stick tape can be used under a smaller inlay template, however this is sometimes not strong enough to hold in place.

Since some of these kits are different than others, measure the thickness of the collar on the bushing and use a piece of wood that is 1/8" to 1/4" thicker. This way when the router is going around the template, there is no way the bushing and collar can hit the wood below the template.

Also, do not make the template so thick that the carbide cutter cannot cut deep enough. On the pass that cuts the inlay piece, the router bit tip will need to be a little over 1/8" beyond the depth of the template, so do not make the template so thick that the bit cannot cut deep enough for the positive inlay piece. Making the template just a little bit thicker than the size of the collar seems to work the best for most instances.

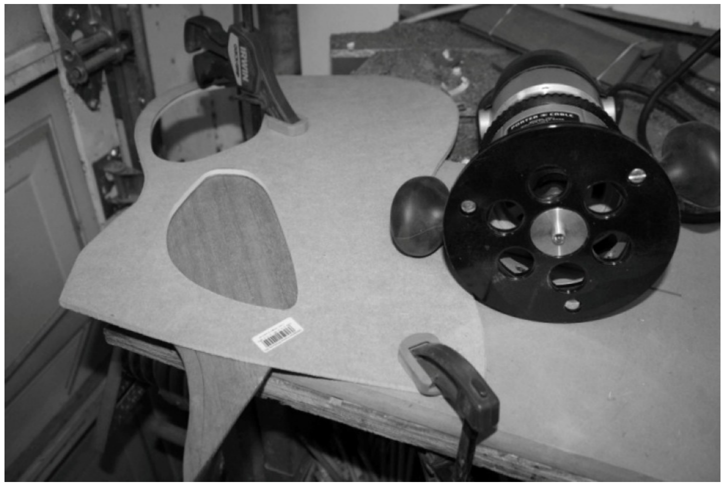


The template is created by first drawing out the shape that will be inlaid. This can be as simple as some small boxes, or as elaborate as a vine pattern. Once the pattern is laid out, an inside cut needs to be made to remove the drawn pattern, leaving behind a hole that will be the template.

An inside cut is a cut where there are no entrance and exit cuts, and are most often done with a scroll saw, jig saw, or coping saw. Each of these have their advantages, but they all require the same few steps in the beginning.

In the diagram in the left column, drawing A shows the wood piece with the layout marked for cutting. The next step is to drill a hole near the edge of the line as in drawing B, making sure not to go over the line with the hole. This will allow access for the scroll saw, jig saw, or coping saw. Thread the saw blade through the hole and cut out the remainder on the inside like in drawing C.

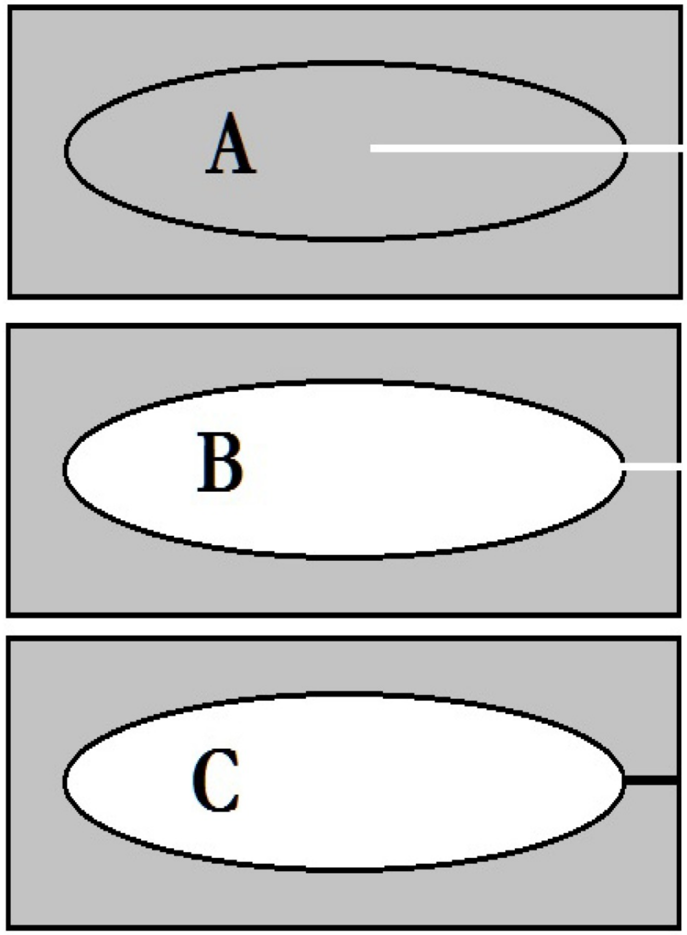
Once the template looks like drawing C, the shape must be refined using sandpaper. Be careful to keep the walls of the template vertical while sanding, and remove any bumps that the saw blade may have left. If there are bumps on the template there will be bumps on the inlay, which will be very easy to see.



Once the template has been cut out of the wood, test it on a piece of scrap to see how well it cuts. This is also a good time to look into the size of the template, and see if it needs to be refined.

The bushing and brass collar on the router move the cutter away from the template walls, making the final piece cut from the template a little smaller on all sides than the template itself. This has to be worked into the calculation for the size of the template, to ensure that the piece created by it will be the right size.

Measure from the outside edge of the cutter bit while in the router, to the outside edge of the brass collar. This is the distance that the template needs to be enlarged by on all sides in order to cut out a certain sized inlay. Do the math to make a template for a certain sized piece, or just make the template a little smaller than necessary. With the smaller template, the test cut can be made, and a little more wood can be sawn from the template walls in order to get it to the correct size. Sometimes trial and error are easier than measuring, but it can be done wither way.

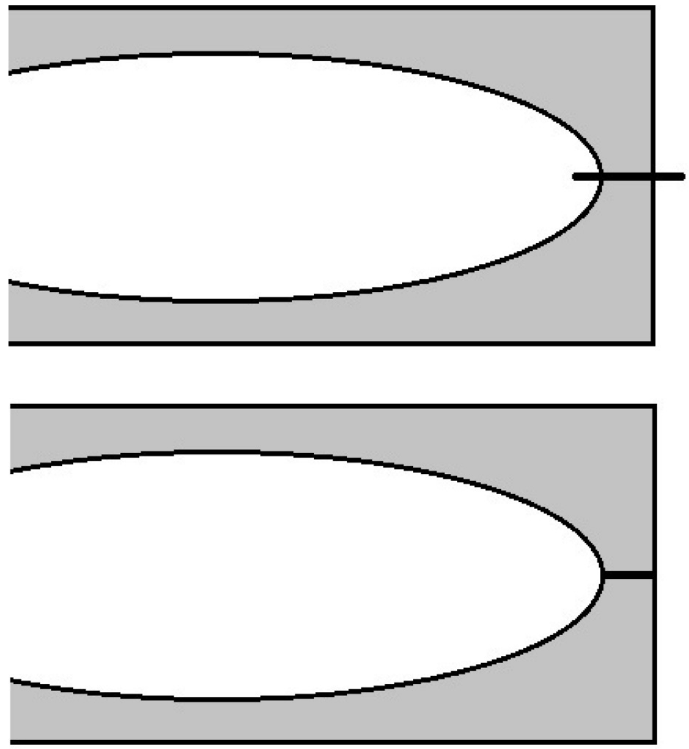


If a band saw is the only thing available to cut with, there is a way to make an inside cut without cutting and welding the blade. This method takes a little longer because of the time required for the glue to dry, however it makes an excellent cut.

Enter the piece with the band saw as in drawing A in the above diagram. Go as straight as possible while cutting through the edge of the template because this will have to be straight for the last step.

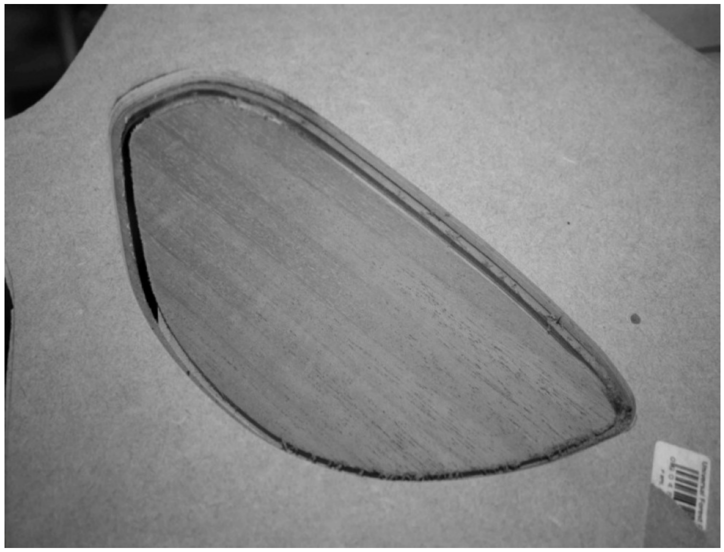
Once in the center of the piece, begin making cuts to the sides in order to free up a few little pieces to give the band saw room to move around. Now the band saw is inside the drawing, meaning it can make the cut around the line just like the scroll saw would have.

Complete the cut following inside the line carefully, stopping the band saw from time to time to remove any small pieces that are freed through cutting the main line. With the saw off, carefully pull the piece from the blade going out the same way the blade came in.



The small entrance cut now needs to be filled and patched with a small sliver of wood to make the outside rim whole again. Select a thin piece of scrap or cut a small piece, and glue it inside the entrance slot made by the band saw. If a thin piece cannot be found, the entrance cut can be made larger on the band saw to accommodate the thicker piece.

The important thing to have in the end is a smooth inside edge of the template, where the glued in piece is well blended and flush. Once the glued in piece has dried and has been flushed to the inside wall, sand the rest of the inside of the template as normal, getting rid if any rough edges. Now the template is ready to be used.



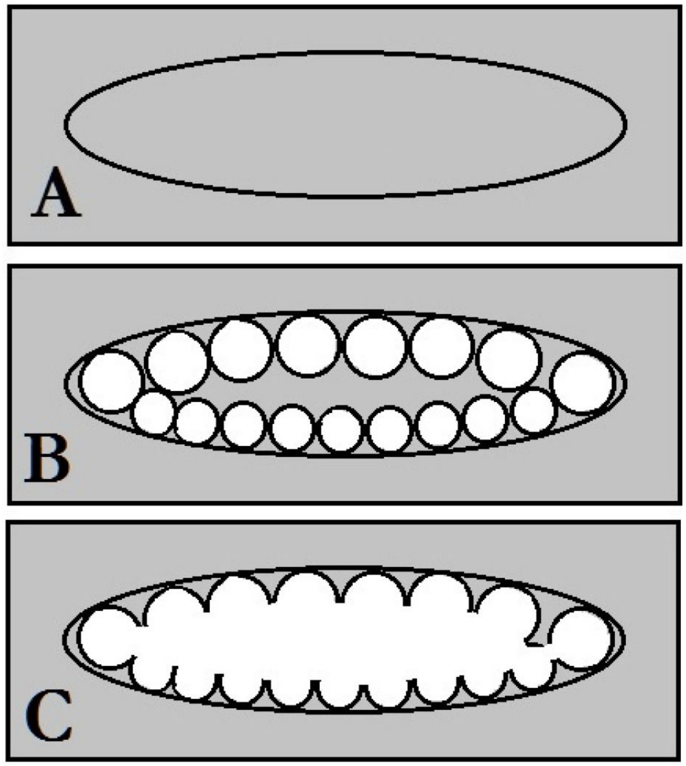
ALTERNATE METHOD TEMPLATE

There are many methods of cutting out the template to use with the router, and all will produce a fine looking template if the time is taken on them. The following are a few more methods which can be used depending on what tools are available in the shop.

Since the router is a necessary tool for the project to begin with, the template may be clamped onto a scrap piece and the router used to remove most of the material inside the line. Be careful with this operation because the router can get away on its own fairly quickly. Come as close to the line as possible without going over it, then switch to sandpaper and refine the final shape.

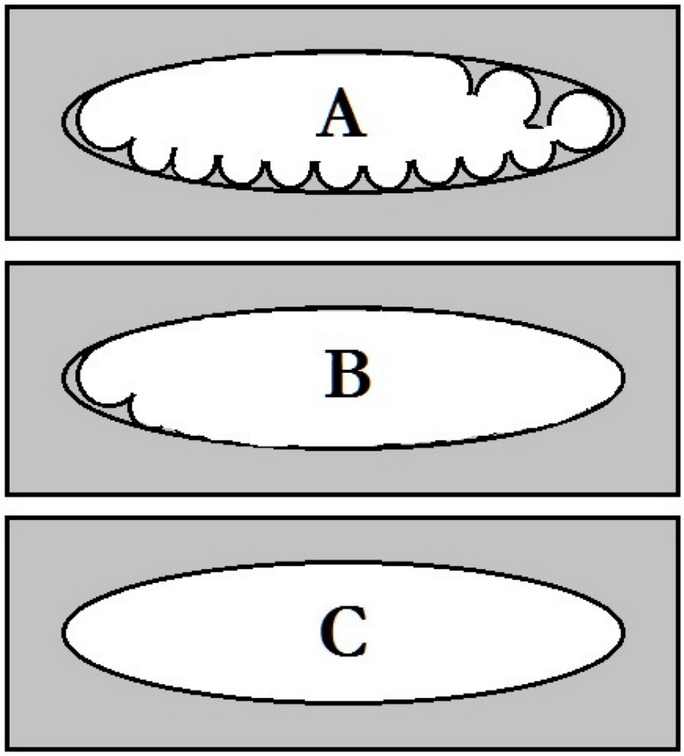
The initial cutting can also be done by hand with a coping saw. A coping saw is a fine cutting hand saw that has a deep throat, and its blades can be threaded through holes. This works much the same way that the scroll saw does, though much slower because there is no power behind it.

Thread the saw through a hole drilled inside the part of the template to be cut out, and saw around the line. Finish with sandpaper like normal, and the template will be ready to use.



The last method to be described uses a drill press to remove the bulk of the waste from the template. Start with the piece looking like drawing A in the above diagram, which is just the template design drawn on the wood. Chuck a large diameter drill bit, and begin making holes along the inside edge of the line. Do not go over the line, and keep the holes tightly spaced so they almost touch. The piece should now look like drawing B on the left.

With a chisel, remove the large piece of waste in the middle, being careful not to tear anything that will ruin the template. The piece will now have a large hole in the middle, and look like drawing C on the left hand column.



Next, begin by using a chisel to remove as much of the small points left behind by the drilling, but not going over the line. A round gouge will work best for this, however a square chisel can work too as long as it is not used very close to the line. At the start of this, the piece will look like drawing A above.

Once more and more of the points are removed with the chisel, and the majority of the waste is removed, the piece will start to look like drawing B, where it is almost ready for sanding.

Piece C above shows the final template, after all the sanding has taken place, and the lines are smooth and well refined.

Project Notes:

No matter which method is used to make the template, the important thing is to make sure it is smooth on the inside, and is made to the proper size. A well made template will make great inlays, and a poorly made template poor inlays. There are many methods to making the template, but they all require taking the time to make it well.

Chapter Seven

TIPS, TRICKS, AND IDEAS

There are several guitar making and wood working items that fall into the category of general knowledge, and really do not fit neatly into another area. These are mostly small things, however they will make a big difference in how smoothly the process goes along.

These are techniques that are picked up over years and years of working in the shop, and normally require hands on experience to learn. Hopefully this will cut out some of the trial and error, which will make learning them much less frustrating.

Many times when an error occurs in woodworking, it is simply because the person making the piece did not know about a certain property or technique. However, now that the piece they were working on will need additional work to fix the error, they have suddenly become familiar with it. It is unfortunate that the only time we really learn about woodworking rules is when we break them, causing an additional repair or more work.

The purpose of this section, especially the last portion where many tips and tricks are explained, is to help the new guitar maker get past some of these hurtles without having to make the mistakes themselves. Making mistakes is not a terrible thing, and much is learned from them. However, if the knowledge can be learned first, and the mistake avoided, this makes an even better guitar maker out of everyone.

Take the time to go through these techniques, and commit them to memory. Knowing which glue to use, how to sand effectively, and what to do when a gap needs filling, makes the guitar making process go far more smoothly. Less mistakes will be made, and more time will be spent building rather than repairing.

The final section in this chapter contains nearly forty woodworking and guitar making tips, that will help anyone become a better builder. They seem like simple or even sometimes unrelated things,

however they will make a difference in the quality and the quantity of guitars made each year.

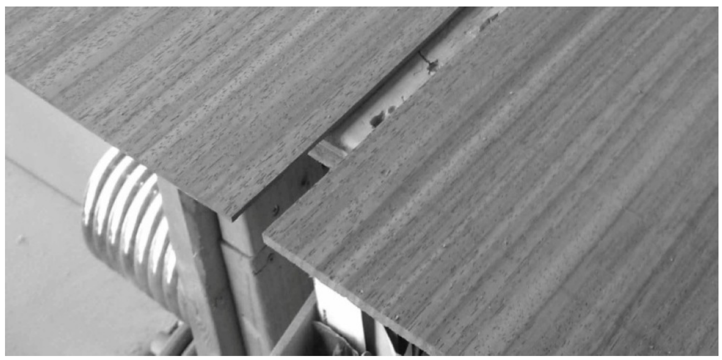
Something as simple as keeping a clean shop can have far more of an impact on the work being done than it sounds. Time spent looking for tools, digging through drawers or piles of sawdust trying to find something, and disorganization in general can easily rob a lot of time that could have been spent building an instrument. Especially for those of us who only have so much time to work on our instruments, losing a few minutes here and there trying to wade through a messy shop can really slow down any accomplishments that would have been made that day.

Learn from the examples in the last section and try to incorporate some of them into the shop process. They will save time, reduce frustration, and lead to overall better guitar making. Try to keep a clean shop, an active scrap bin, have all edged tools sharpened, and listen to the tone made by the different wooden pieces often. These few changes will make big differences, especially in the stress level while in the shop.

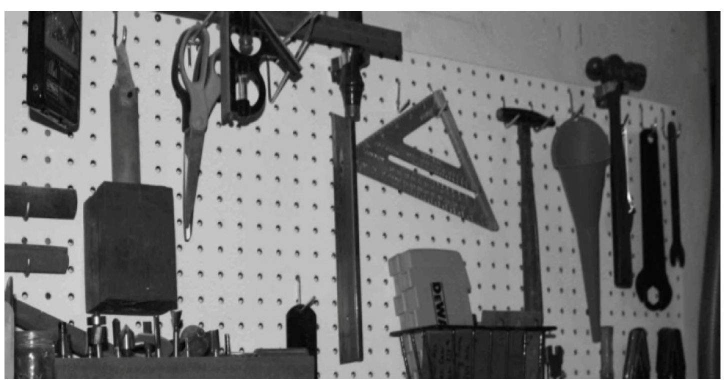
In This Section We Will Cover:

Different types of glues, and how each one fits into guitar making. See here.

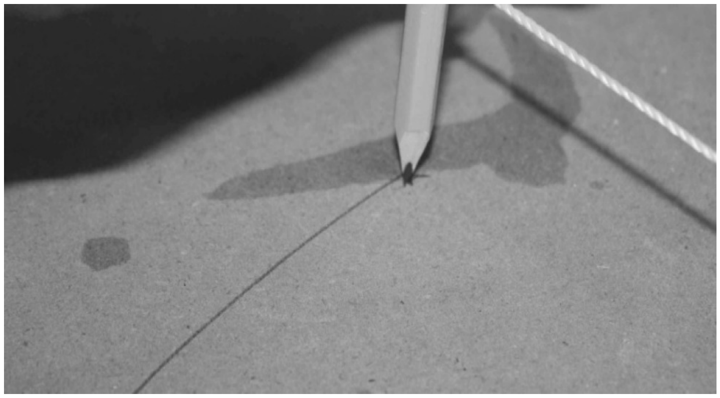
How to make strong wood to wood joints with glue. See here.



How to sand properly, and why sanding past 220 grit is a waste of time. See here.



How adding peg boards around the shop will help keep everything within reach. See here.

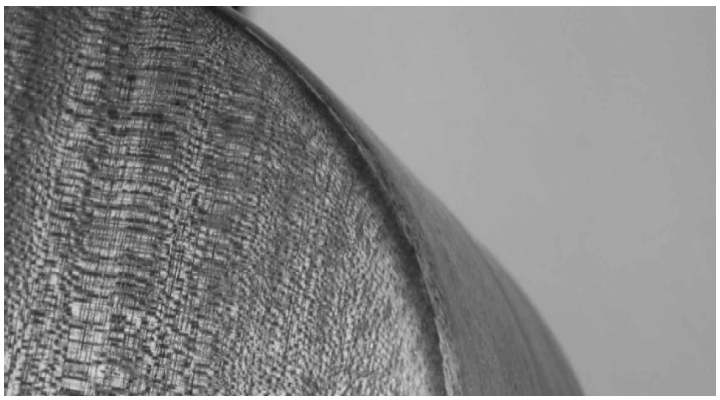


How to use a piece of string and a pencil to mark a large radius. See here.

Using a couple machine screws to help glue the bridge to the soundboard. See here.

Using a contrasting piece of wood on the 12th fret for an inlay. See here.

How to make perfectly color matched wood fills any time they are needed. See here.



An easy alternative to binding the guitar which involves rounding over the edges. See here.

Woodworking tips and tricks for an easier and better time making guitars. See here.

Project Notes:

There are many tips, tricks, and ideas that just come up when making something in the shop, and they deserve to be written down so they are remembered. Chapter four discusses how keeping a notebook full of data and ideas is very important for woodworkers. Adding any of these concepts to that notebook will help to ensure they are remembered as well as practiced in the shop.

TYPES OF GLUE FOR GUITAR MAKERS

There are many different types of glue that are available to woodworkers, and some are better for guitar making than others. Certain glues will be used almost exclusively except for certain situations where a specific type will work better. An entire guitar can be made with only using one type of glue, however knowing the differences between them will make a difference in choosing the right glue for the job.

The bread and butter of guitar making and wood working in general is Aliphatic Resin glue, also known as AR glue. This is the common yellow wood glue that is seen in every woodworking shop, and for good reason. This glue creates a joint that is stronger than the wood itself, has a long enough open time that it can be worked with easily, and dries fast enough that it does not delay the project.

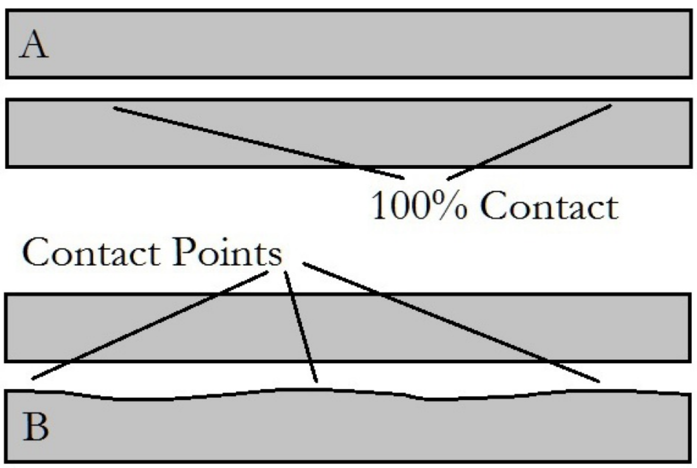
Titebond pretty much owns the market on wood glue, and they have several different types to choose from. The main difference between any of their products is how well it resists water or temperature. For most guitar making needs, Titebond Original in the red bottle will be the best choice of the products Titebond offers.

Titebond Original can be clamped for as little as 30 minutes before working with the piece, however the joint cannot be stressed for 24

hours until the glue has had the time it needs to fully cure. For most guitar making applications, clamping for a few hours is recommended due to the fact that the joints will be stressed when working on them.

AR glues are also resistant to the heat that is created when sanding the wood, and where most white glues will fail, AR will not. The excess glue will dry with a dull yellow color, which is easily seen for removal later on. The glue can be sanded off, scraped off, or chiseled off, and it will not affect the joint in any way.

To use the glue, the mating surfaces must be clean, free of any grease or oils, and free from any sawdust or debris. The surfaces themselves also need to mate well, meaning there should be no gaps between the two pieces.

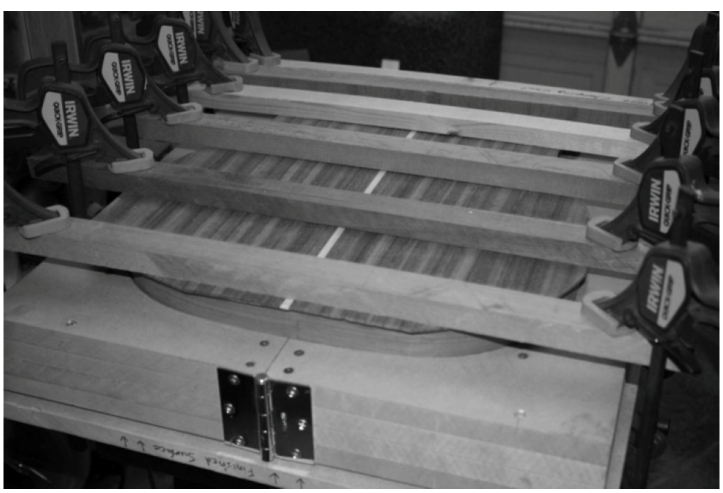


The diagram above shows two sets of boards being glued together. The top set has perfectly flat surfaces between them, making a joint with 100% surface contact between the two pieces. This is the perfect way to make a glue joint, because the largest amount of wood will be touching each other.

The bottom set shows an exaggerated look at a flat board being glued to a not so flat board. The surfaces that are able to make contact, which is required for the glue to work, are only a few. They will hold in the beginning, however over time they may work loose, because only a small percentage of the wood is actually touching.

Getting the maximum amount of wood to touch prior to gluing the boards together will increase the ability of the joint to hold up under the pressures that it will endure during use.

Another thing that is great about AR glue is the cleanup is very easy. While the joints are being clamped, a wet rag can be used to remove as much of the liquid glue as possible before it dries. This will make it much easier to clean up the piece afterwards, and will reduce the chances of the wood being gouged while trying to remove the dry chunks. It is a good practice to clean up as much of the wet glue as possible while the clamps are in position, to minimize the struggle later. It is much easier to wipe wet glue away than it is to sand, scrape, or chisel it off later.



This glue will be used for the vast majority of the guitar making process, and is the choice for any wood to wood contact that will need gluing. Purchase a name brand glue like Titebond, because so much of the structure of the guitar will depend on the quality of the glue being used. A cheap glue might save a few dollars, but in the long run it will not be worth it. A guitar could last 50, 75, or 100 years, making the extra few dollars really mean nothing when compared with how long it will last.

Hide glue is the traditional choice for many wood workers, especially those who make classical instruments like the violin or cello. Hide glue is made from animal hides, bones, and connective tissues, that have been boiled down into a thick syrup. This syrup is then dried into small bricks, and crushed into powder when sold.

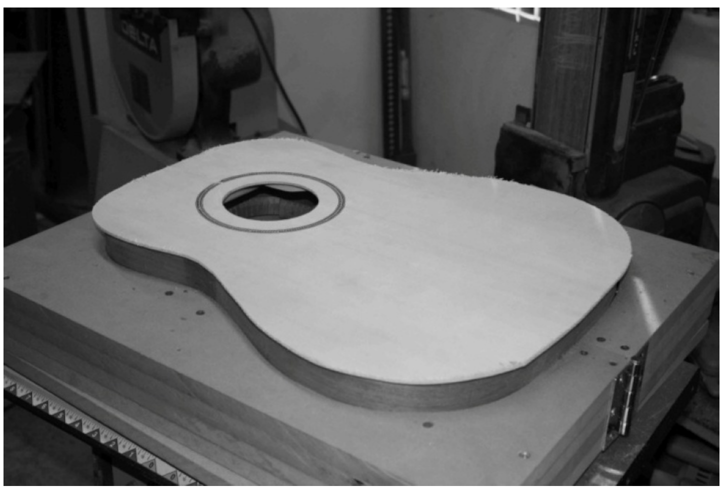
Hide glue holds the title of the oldest form of glue known to the world. There are examples of furniture made for Egyptian Pharos where hide glue had been used, and the pieces are still standing in museums today. The first written recipes were discovered during Egyptian times, though there are examples of hide glue being used 4000 years earlier than that. As a glue with the longest track record, nothing can match hide glue.

Of the interesting properties of hide glue, the three that are the most desired are the ability to resist creeping over time, how the glue pulls together when drying, and how the joints can be reversed if needed later on.

Many glues will move over time if the joints are left under tension. This movement is minimal, but it still occurs. Due to how hide glue

dries, it cannot move at all no matter the tension the joint may be under. For acoustic guitars, the bridge is under a great deal of tension, and can benefit from being glued down with hide glue. AR glue will work well because of how the bridge is designed, being locked in place to the top and bridge plate, however hide glue will keep a bridge from moving even one molecule closer to the neck.

Hide glue also has an interesting property of contracting as it dries over a large surface, effectively pulling the surrounding surface tighter. A piece of linen cloth can be soaked in hide glue and used as a reinforcement patch on the ends of the braces. This patch will adhere itself to the braces and the plate, and then pull tightly as it dries. This will add a small clamping effect, and help hold everything together.



The biggest benefit to using hide glue, and the reason so many classical instrument makers use it, is because the joints can be reversed if needed. With violins and members of that family, sometimes the instrument needs to be taken apart for repair. This can involve removing the plates from the ribs, the neck from the body, and the fingerboard from the neck. If regular wood glue was used, it would be a nightmare to separate the pieces.

Hide glue joints can easily be separated by using heat, steam, and moisture to break down the bond in the joint. Once a small opening has been created, a thin knife is used to work around the rest of the joint, slowly separating the two pieces. Once the repair work has been completed, the old glue can be scraped off before coating with fresh glue and clamping again.

This procedure can be repeated as many times as needed, and the new joint will be just as strong.

Using hide glue involves measuring out an amount of hide glue granules by weight, then adding 1-1/2 to 2 times that much weight in water. This must be done by weight, and not by volume. The water will weigh more than the glue granules, meaning that the volumes will be very similar when combined.

Let the glue and the water stand in a glass jar for a while, stirring it occasionally to prevent it from clumping. Once the mixture has absorbed the water and the glue looks like brown gelatin, it needs to be heated.

Using a double boiler, the hide glue mixture is heated to between 140-150 degrees, and held there while being used. The consistency should be like thin syrup, and it should have an aroma that is interesting to say the least. Instructions for making a very inexpensive hide glue pot in the shop can be found in chapter two.

A brush is used to apply glue to the two surfaces of the wood that will be mating, and the pieces are put together. They are rubbed back and forth a little to spread out the glue between them, and then they are clamped. All of this must be done quickly, because hide glue begins to set up as soon as it cools down.

Clamp the piece for a couple hours, then remove the clamps and continue with the next steps in the project.

Hide glue does require a little more involvement than AR glue does, however there is no better choice for the guitar maker who wants to follow the traditional paths that were forged by the old masters centuries ago.

A third type of glue is Polyurethane Glue, which is commonly referred to as Gorilla Glue, because that is the most likely brand to see in the stores. It is relatively new when compared to AR glue, and has some interesting properties. Though this is a popular glue, its value in guitar making is not as much as a person would think. The reasons for this will be explained below.

Polyurethane glue is extremely versatile in the fact that it can be used to glue almost anything to almost anything else. Wood to stone, stone

to brick, metal to wood, polyurethane glue excels at doing it all well. The downside for guitar making is that since guitars are only made from wood, this property is fairly useless.

Another interesting thing about polyurethane glue is that is foams and expands as it cures, filling any gaps between the pieces being glued. While this sounds great, in guitar making the joints should fit well in the first place, not need the glue to expand and fill gaps.

The expansion of the glue actually will cause more problems than it will fix, because the residue can be brutal to remove after the foam has dried. Scraping AR glue is a walk in the park when compared to removing polyurethane glue residue, and this can cause problems with finishing the wood.

Overall, polyurethane glue is great for outdoor projects, and gluing different things to each other, however it does not work as well as AR glue for woodworking.

The main company that manufacturers polyurethane glue (The Gorilla Glue Company) actually came out with an PVA wood glue, which reportedly works well on wood to wood joints.

If Gorilla glue absolutely has to be used, then use their wood glue instead of their polyurethane glue. It will work better for woodworking applications, require less cleanup, and be a far better product in the long run.

Epoxies come in a lot of varieties for different applications and drying times. There are epoxies that are very good for guitar making and

there are also some that are very bad. Epoxy is typically used as a method of gluing something non-wood to something wood, which happens most when inlaying shell or other materials on the fretboard.

The qualifications for a good guitar making epoxy are that it is a name brand that has been around for a while, it dries clear, and it does not dry too fast to work with. Typically a name brand clear drying 30 minute epoxy is the easiest and most versatile type to use for any inlay work.

The advantage of a clear drying epoxy over a yellowing type, is that it can fill small hairline gaps between inlay pieces and the surrounding wood, blending the difference away. When looked at, the hairline gap or small area where the inlay cavity was too wide will appear the same color as the surrounding wood. This will help conceal any small irregularities that may occur with being a beginner at inlaying.

Epoxy is mixed on demand from two separate containers. One containing the resin, and the other containing the hardener. In this way, only the needed amount of epoxy has to be prepared before actually using it. Once the two are mixed, they are ready to use immediately, and will stay fluid for about 30 minutes or so, depending on the time listed on the box. Temperature will also effect this curing time to an extent, so expect a little more time in colder and more humid climates and less in warmer and dryer areas.

When inlaying material in the fretboard, brush a layer of epoxy on all surfaces of the cavity first, then gently tap the inlay piece into the hole. The epoxy should squeeze out all around the inlay piece, filling any gaps. Any large excess can be wiped away with a wet rag, however be careful about getting the epoxy into the pores of the wood. It is easy enough to sand through the dried epoxy later anyway, and once the inlay is sanded flush to the surface of the fretboard it will be a great looking fit.

Cyanoacrylate glues, sometimes called CA glues or super glues are also a common glue type used for guitar making. These are often used to adhere inlays in the same manner as the epoxy is used. They come in a variety of viscosities from super thin to gel, and they can be sprayed with an accelerator to dry them instantly.

CA glues that work the best for inlaying are the thicker types, because they can be controlled better to go where they need to. Super thin glue will seep into the wood like water and not adhere the inlay very well. A thick name brand glue is a no mix version of the epoxy covered earlier, and can be used any time something non-wood needs to be adhered to something made of wood, such as inlaying.

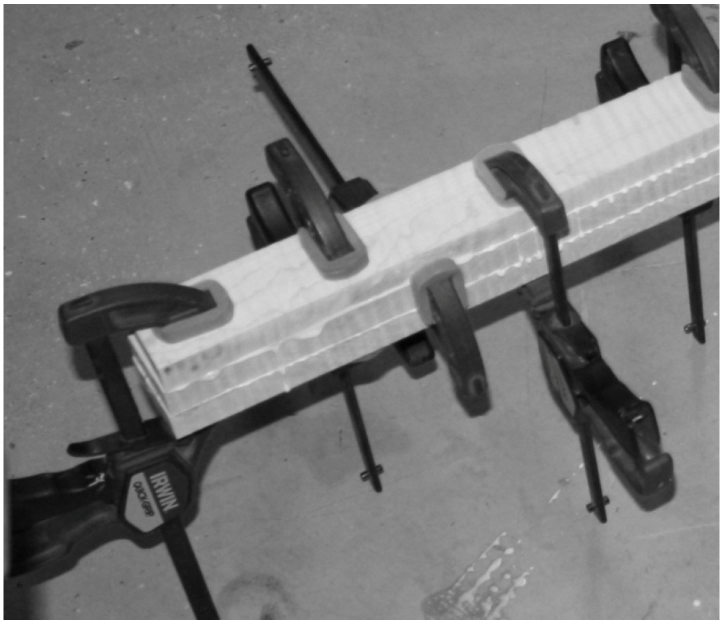
HOW TO GLUE WOOD TOGETHER

When gluing two pieces of wood together, it is very important to make sure that the entire surface that will be meeting has glue on it. This means using a finger or a glue roller to spread out the line of glue until it touches every part of the joining surfaces.

When gluing two pieces of wood together, begin by dripping glue all over the surfaces that will be clamped together. Do not put glue on one side only, put glue on both. Using a finger, glue brush, or other glue spreading method, move the glue around until the entire surface is coated without any dry spots. Areas that are dry sometimes end up not getting any glue at all, and they will show up as cracks and gaps if the glued up piece is cut or sanded.

It is difficult to describe exactly how much glue needs to be applied to each face, though in general, less is more. There should be just enough of the glue to easily coat the entire face of the piece without any large pools, or areas of very thick coverage. If too much glue is applied, it can be wiped off with the finger and then onto a towel. Do not use a towel to wipe directly on the wood, because it can leave fibers behind that will end up in the glue joint.

Clamping the pieces together is the final step to a good glue joint, Place the two meeting surfaces together and slide them back and forth half an inch or so to get the two surfaces stuck together. Apply as many clamps as can be fit on the two boards, and in general more clamps are better than less.



When applying the clamps, get them into position and only tighten them to medium tension until all the clamps are in place. Then, go back and tighten them down more, which will cause the glue to squeeze out of the joint. As the clamps are being tightened, make sure the two pieces stay lined up well, and do not slide apart. If they cannot be stopped, use a clamp on the seam to hold the pieces together correctly. In the picture in the left column, the third clamp from the left is used to keep the three boards from sliding apart from the pressure of the other clamps.

Inspect the joints all around the glue up to make sure there are no gaps or areas where the pieces are sliding apart. If there are, add more clamps to correct the problem.

When the inspection is completed, use a wet rag to remove as much glue squeeze out as possible, taking care not to wet the joints too much. Once the majority of the squeeze out is taken care of, the piece can be left to rest until the glue dries.

Carefully remove the clamps after the glue has dried for several hours or better overnight. Inspect the joint and make sure that the pieces adhered to each other well. Clean off any residual dried glue with a chisel, cabinet scraper, or by sanding.

Project Notes:

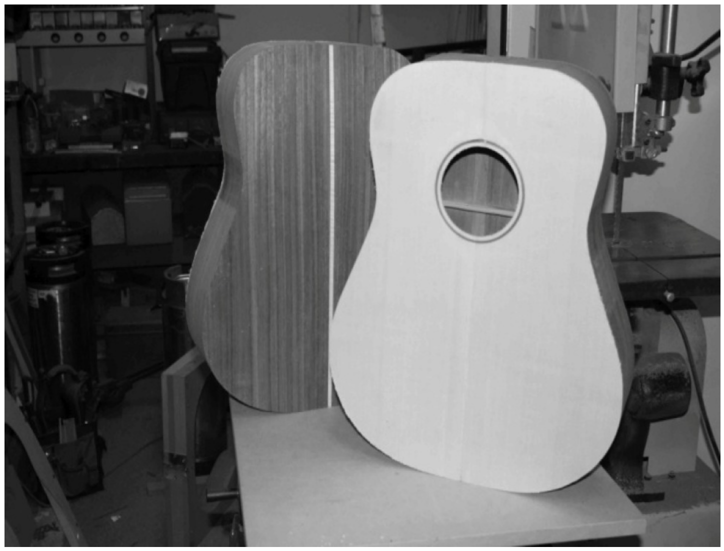
There are three important aspects involved in gluing one thing to another thing, and as long as they are followed, they will result in strong glue joints. Since gluing is a large part of guitar making, it is worth some time to make a few practice pieces to get the technique down.

First, the joints that are meeting will need to be completely flat, and mate well. This means that a lumpy board should not be glued to another lumpy board. This will result in a very small area of contact between the pieces, and therefore a very weak glue bond. Ensure that the surfaces are flat, smooth, and free from sawdust and debris when gluing. The joint will set much stronger, and the glue line will be less visible this way.

Second, make sure to completely cover both mating surfaces with a thin layer of glue prior to bringing them together. Putting glue on both sides sounds redundant, but it helps ensure that there is glue contact along the entire surface. A joint will only be as good as the contact between the wood, and the glue between the faces. If there is no glue in a certain area, there will be no adhesion in that area.

Lastly, clamp the pieces together well and give the joint adequate time to cure. This will mean overnight in most cases. Follow these three keys to gluing, and the chances of a joint failing in the future will be very slim.

SANDING PAST 220 IS WASTED TIME



The part of guitar making that most often frustrates people, is the perceived amount of sanding that has to be done before finishing. In most cases, there is far less sanding that will need to be done than people think. The errors made the most often while sanding are sanding too long and sanding too finely, each of which will make the process take far longer than it should.

When sanding a piece of wood, no matter how long it is sanded at a certain grit level, it will never be any finer than that grit level. Sanding with 100 grit paper for 10 minutes will produce a 100 grit surface on the wood. Just the same, sanding with 100 grit paper for ten hours straight will also produce a surface that is 100 grit. The results will be the same, though the effort required will be vastly different.

Once a surface has been sanded level, and there are no marks to remove from a previous sanding, the process at that grit level is complete. At this point, the paper should be switched for something finer.

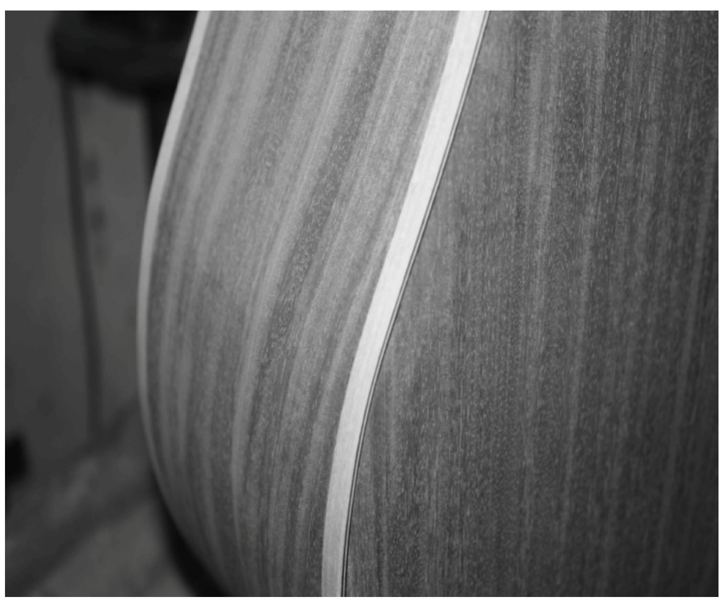
Lastly, sanding past 220 grit in almost every case is completely unnecessary. Most finishes will leave a slightly rough surface when applied, and sanding to anything past 220 typically does not encourage a smoother look. Once the finish is applied, even a piece sanded to 12000 grit will still

need additional sanding on the finish itself to level it, and will not be any smoother than a piece only sanded to 220 grit before finishing. Sand the guitar down to 220 grit, making the last strokes following the grain. This will be all that is needed for an excellent looking finish.

To effectively sand a piece of wood, select the finest paper possible that will still allow the quick removal of scratches and level the piece. Match the sandpaper to the project, and a quicker and better experience will result.

If a guitar top requires a large amount of sanding due to ineffective work with the hand plane, start with 100 grit paper and a flat sanding block. The block will distribute the force of the sandpaper, and encourage flatness in the guitar top. Once the bulk has been leveled, and the large plane marks are gone, it is immediately time to switch to a finer paper to remove the scratches from the 100 grit.

Place a piece of 150 grit paper on the block, and sand with the grain until all the scratches from the 100 grit are gone. At this point, there is nothing more that can be done with the 150 grit, and it is again time to change papers.



Finally, apply a piece of 220 grit to the sanding block, and continue in the same manner, removing scratches that were left behind by the 150 grit paper. Once those are gone, dust off the piece using a dry

paintbrush or a piece of clean cloth. At this point the piece can be inspected for any hidden scratches.

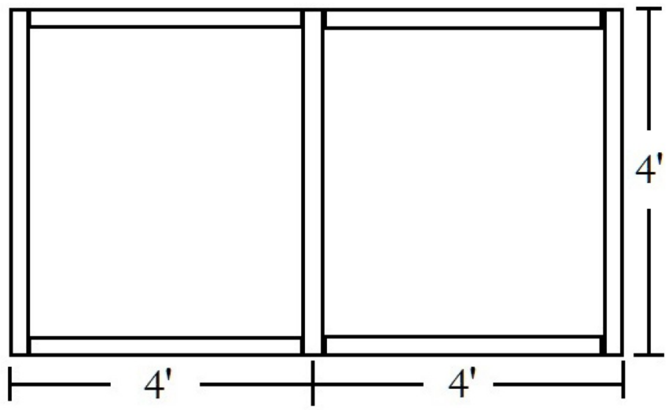
Hold the guitar in a glancing light, and slowly go over every inch of the surface looking for any scratches. The light will help make it easier to see these small imperfections, and they can be dealt with immediately after they are found. The inspection period is the most important part of the sanding process, because this is where any final marks will be caught and eliminated, resulting in a very smooth surface to apply finish.

Once the piece is scratch free, and completely smoothed out with 220 grit paper, it is time to raise the grain if needed, then begin applying a finish. The finish itself will have a little more to adhere to since the surface was not sanded down to a super fine grit, and the final look will be exactly the same as if it were.

PEGBOARD FOR TOOL STORAGE

Having adequate storage can be a challenge in a small shop, however if a little creativity is applied it can be very easy to add storage space for tools. The best way to get the most storage for the least amount of floor space is to use a peg board on the wall. The walls are typically not thought of as spaces for tool storage, however a well placed peg board can hold an entire toolbox full of tools, and not take up any floor space at all. Especially for those working in a single car garage size space or smaller, making the most out of the space available is very important.

Peg board can be purchased from just about any home improvement store in large sheets that are 4' x 8' in size. These are perfect for putting up on the wall just as they are without cutting them down. They do require a little framing out on the back to help them hold to the wall, however that is really it.



The peg board cannot be attached to the wall directly because the pegs will need to be pushed through in order to hold tools. However, it is a simple matter of making a frame out of 1x1 or 1x2 boards, that will keep the peg board half an inch or so away from the wall. This will also provide some rigidity to the peg board, as well as a little extra meat to screw it to the wall with.

Assemble a frame around the back side of the peg board using several pieces of very thin and small lumber. The reason for small pieces is that anywhere the lumber is, pegs will not be able to go through the board. Several 1x1 or 2x2 pieces arranged like the diagram in the previous column will work very well. Attach them to the peg board using small wood screws and glue, screwing through from the peg board side.

Place one vertical piece of the same wood down the middle for support and to keep the center of the peg board from sagging. Only one piece will be needed to keep the peg board rigid, and again a small board minimizes the number of peg holes covered.

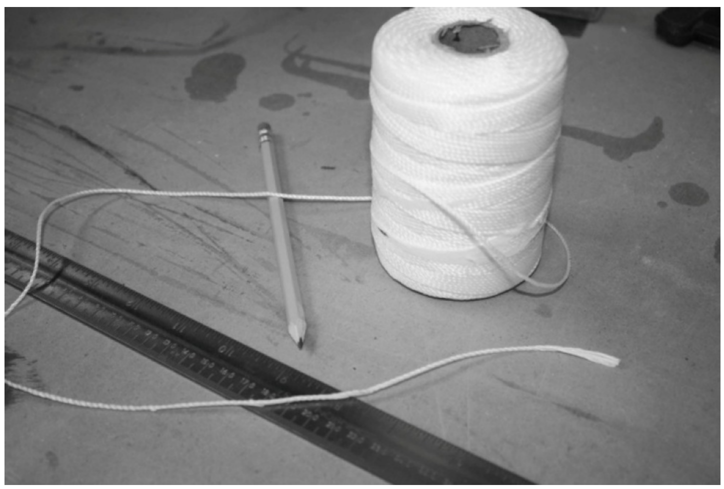
Once the frame is in place, find a few stud locations on the wall, and send some long wood screws through the entire structure, fixing it to the wall. Make sure to secure it very well, leaning on the side of too many screws instead of too few. There will be potentially hundreds of not thousands of dollars worth of tools hanging from this peg board, and they are worth a few more screws.

Project Notes:

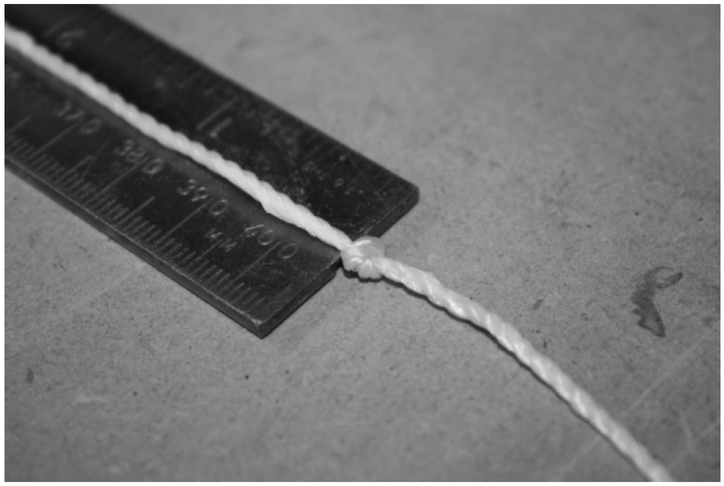
A small peg board placed over the bench is a very easy addition that can place many often used tools right within reach all the time. Also, a peg board can be cut for the side of the workbench, the side of a table, or anywhere else a flat vertical surface is available. Peg board is cheap, and the pegs last forever, so transforming vertical space into convenient tool storage is a very easy shop improvement.

RADIUS MARKING WITH STRING

Many times in guitar making there will be the need to mark a radius onto something else, and this can be difficult to do since a compass only opens so far. A simple and not completely inaccurate method of measuring and marking a radius, is to use a piece of string of a known length tied to a pencil. The string limits the distance that the pencil can be pulled, effectively marking a radius.

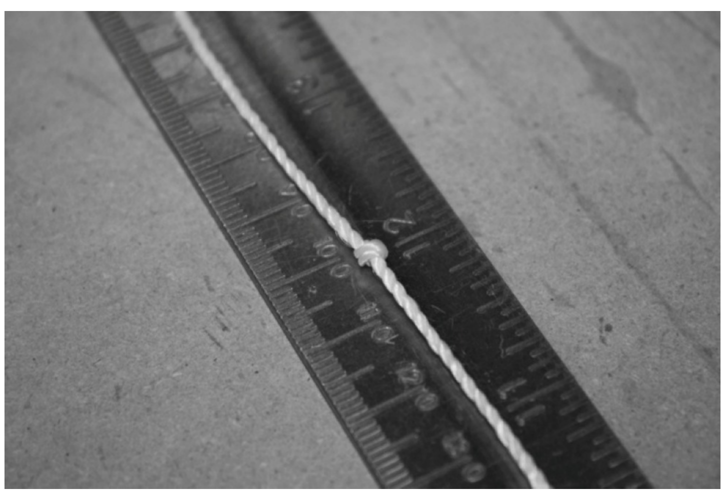


To begin, a length of string, a ruler, and a pencil will be needed. The string will be measured against the ruler for an accurate radius, and the type purchased should be stiff and not stretch when the ends are pulled.



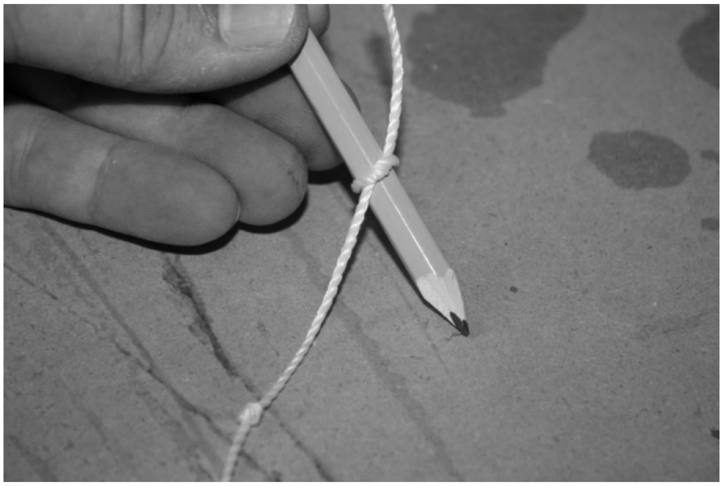
First, lay a few inches of slack past the beginning of the ruler and tie a small knot. This should be 4" - 6" away from the end of the string, and line it up against the edge of the ruler. It is from here that all the measurements will take place, and the length of the radius determined.

If a longer radius is needed, switch from a metal ruler to a tape measure, however most of the time a standard ruler will have enough length to accommodate most of the needed measurements for guitar makers. Though anything longer can easily be done on a tape measure or large square.



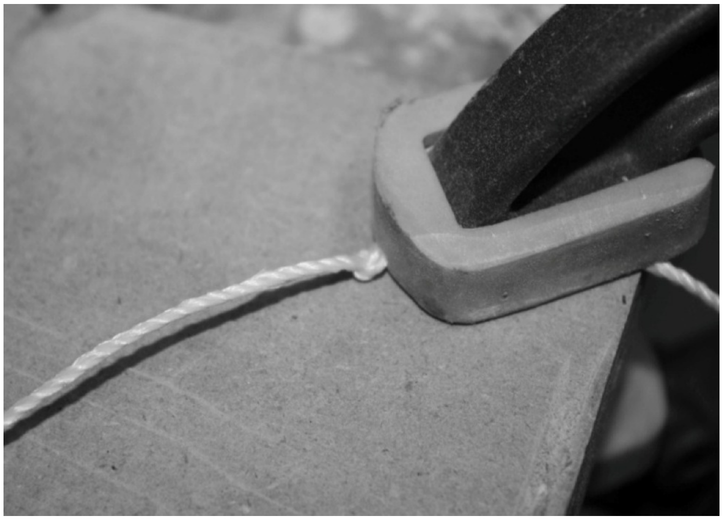
The second knot will need to be tied using the ruler, and placed precisely on the needed radius measurement. In this case the knot was tied over the 12" mark, making this a string that will draw a 12" radius.

This can be a little bit if a challenge at first to tie in the correct place, however it will come fairly quickly. Alternatively, a small black dot can be made with a permanent marker at the same location, though it may be a little harder to see while being used.

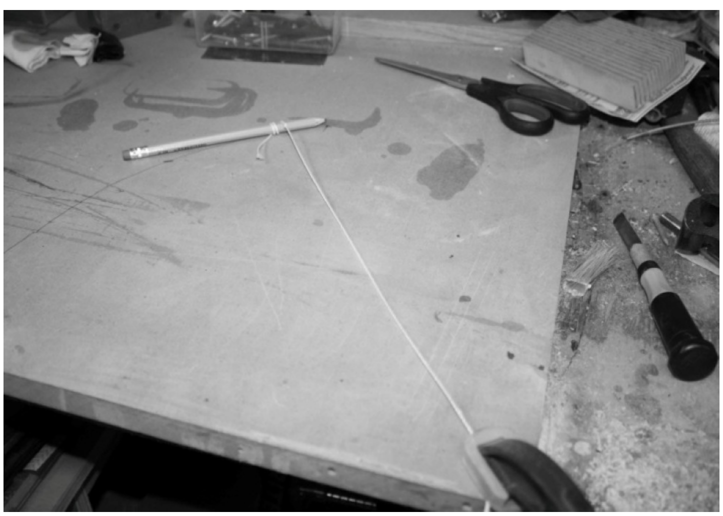


Cut the string a few inches past the new knot, leaving enough slack to tie the string to the pencil easily. Tie it a couple inches away from the knot, which will allow it to be wrapped around the pencil, taking up the extra slack. Once the wrapping is done, tie the loose end around the pencil again, firmly locking the length in place.

For the next steps, a bar clamp will be needed to fasten the end of the string down to the table, though a few other items could be used. A large heavy object can work, as long as it can hold up under the string tension, and even a push pin will do. A small nail and a hammer can secure the fixed end, as well as provide a place to tie additional strings to. However, the easiest and best way to hold the fixed end of the string is to use a bar clamp or C clamp.



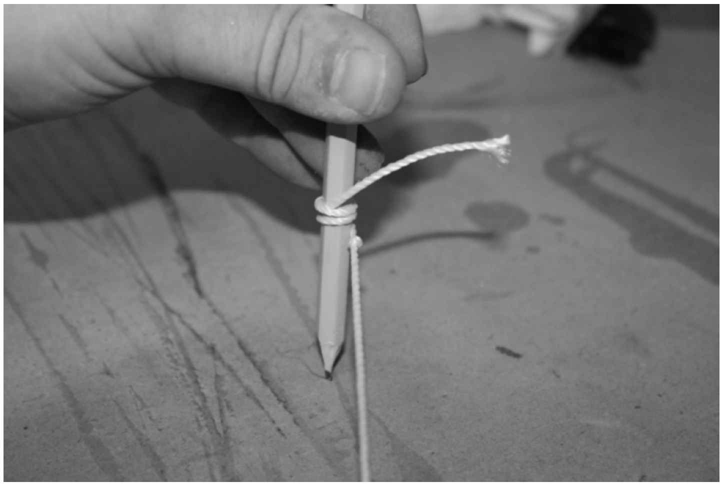
Allowing enough room to draw the radius, find a location to place the bar clamp, and lock the knot against the workbench. The end of the knot should be slightly under the face of the clamp, or in this case right at the face itself. It is important to get this as tightly against the face as possible, in order to ensure a correct radius.



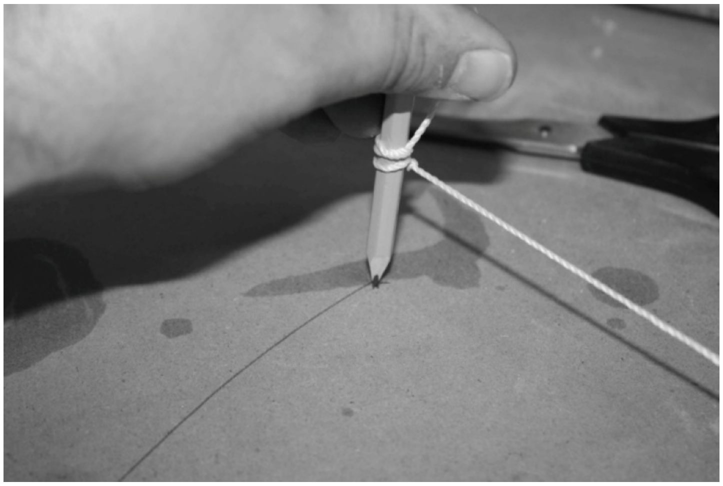
With the end clamped down, the whole setup will look like the picture above. There is plenty of room for the pencil to make a mark, and there is nothing in the path of travel. The string is fully extended, and the radius marking is ready to begin.

Before actually marking anything, extend the pencil and the string over the marking area, and swing it back and forth. This will ensure

that there is nothing in the way of the moving pencil once the process starts. It is much easier to find something in the way before actually marking the radius than to have to stop drawing, move something, and try to begin again.



Pick up the pencil and hold it completely vertical, with the string fully extended. Lower the pencil to the drawing surface, and begin making a slow arc.



Take care to hold the pencil completely vertical, maintain string tension, and follow through with a very even and graceful line. This will now be a radius that has a known measurement, and can be used for measuring and making tools.

Project Notes:

For making simple gauges, and basic layouts for acoustic guitar bodies, this method of drawing a radius is as accurate as it needs to be. For making a radius sanding block, or putting a radius on a fretboard, a more accurate method will be needed than a string and a pencil.

This method is mainly used when laying out full size custom guitar bodies, since all curves have a radius, or a certain measurement. Once this is plotted, it becomes easy to draw out very even and symmetrical guitar bodies, because the radius on each matching piece will be the same. This will lead to better drawn guitar plans, as well as better made guitars.

BRIDGE GLUING SCREWS

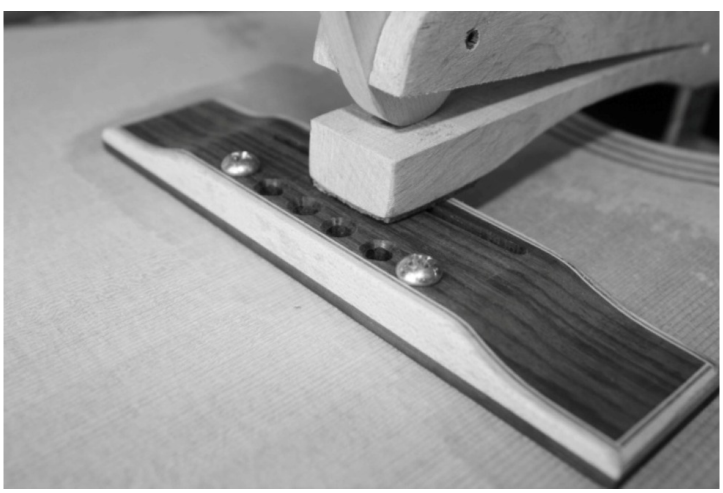
When gluing the bridge to the top of the guitar, sometimes it is difficult to keep it lined up properly. Even with the use of well placed clamps, the bridge can still move as the glue begins to tack, causing the bridge to end up out of position. There are a number to tricks to fixing this problem, and one of those is to use a couple small machine screws to hold the bridge in position while the glue dries.

To begin, the bridge location must be determined and marked on the face of the guitar, simply as a method of realigning the bridge quickly when needed. Measure and place the bridge, and using a very faint pencil, make a few locating marks.

Clamp the bridge in place using a single cam clamp in the center of the bridge. It is important not to cover the high and low E string holes, as they will need to be exposed for drilling later. Check the marks made earlier to see if they still line up well, and realign it if necessary before moving on to the next step.

With the bridge clamped in place, drill through the high and low E bridge pin holes with a sharp 3/16" drill bit. The standard size for bridge pins requires a 3/16" hole to be reamed out for a precise fit of the tapered pins. If a different size set of pins are being used, then use the corresponding drill size.

The picture on the lower left column shows the top of the guitar with the clamp removed from the bridge, exposing the drill locations. This will make it very easy to get into the same position again, once glue has been applied to the bottom of the bridge. Simply line up the holes, and clamp in place.



When it is time to glue the bridge to the body, apply glue to the underside of the bridge, and place it on the top of the guitar. Use the holes

that were drilled as a guide for proper placement, and wait on placing any clamps just yet.

Insert a pair of 3/16" machine screws through the high and low E holes on the bridge, fastening them on the bottom with a wing nut. Washers can be used on the top of the bridge if desired, just make sure they are free of burrs or anything that can damage the bridge when tightened. A pair of plastic washers can be used, which will allow the bolts to be tightened well without any damage to the bridge.

Once the bolts have been tightened, begin placing clamps through the soundhole to hold down the bridge while the glue dries. Clean up any glue squeeze out immediately with a wet rag, because it will be miserable to clean out after it has dried.

Once the bridge has had ample time to dry, remove the clamps and set them aside. Inspect the glue joint to make sure it looks well sealed all the way around, and clear out any residual glue if necessary. A screwdriver can be used to help remove the bolts, which sometimes will stick a little due to some glue getting into the threads.

When the screws have been removed, drill the remaining four holes with the same drill bit, and ream them to the proper size for each bridge pin.

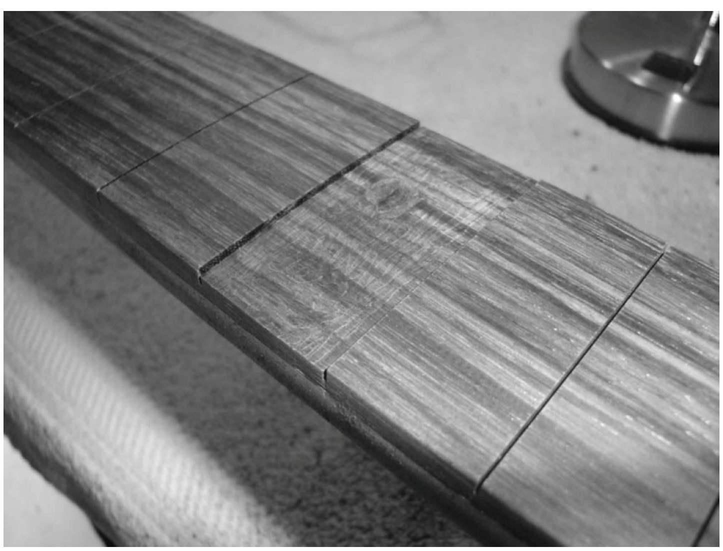
If the screws happened to scratch the bridge, a light sanding should remove them, and consider using plastic washers in the future. This is a very easy and efficient method of locating the bridge in the correct position while gluing, and ensures proper placement each time.

SOLID 12TH FRET INLAY

An interesting and easy change that can be made to a fretboard is to swap out the 12th fret box and inlay a completely different species of wood. This provides contrast as well as highlights the 12th fret, which is a place that is often times embellished by guitar makers.

The bass guitar in the above picture has no fret markers at all on the face of the fretboard, instead it has larger side dots. The only piece that breaks up the Rosewood on the fretboard is the piece of Maple that is inlaid into the 12th fret.

The first thing that will need to be done is to make room for the inlay piece. This will require a Dremel and a router base, or a regular router and a straight bit. The Dremel used here has a round carbide cutter in the collet, and the hole cutting attachment makes a great mini router base. Set the depth for 1/8", which will be plenty deep for a well glued inlay that will hold on tightly for a long time.

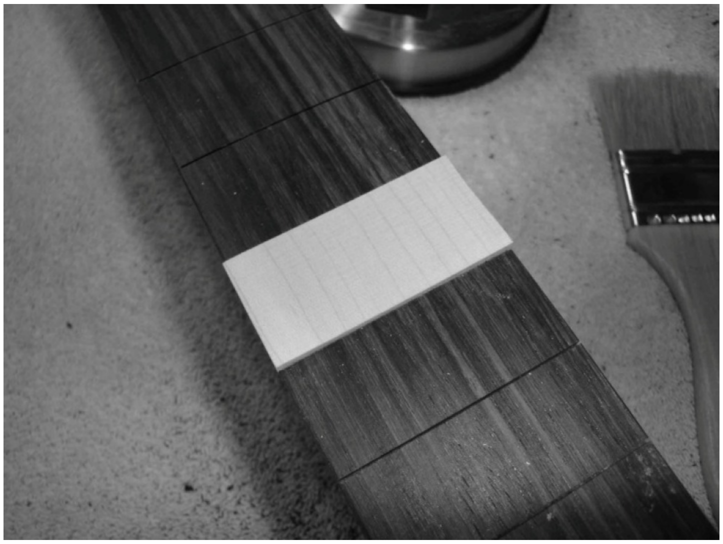


Being careful not to ding the areas on the neighboring frets, use the Dremel or router to remove all of the material inside the fret box. This may take a little time since every last scrap of wood will need to go in order

for the inlay to sit flush. The bits used for this process are very small too, which means that it should take several minutes if it is being done correctly.

As the tool is used, there will be an accumulation of wood shavings that can get in the way of being able to see the work. Blow these off as they become a nuisance.

Select a piece of wood to use as the new 12th fret box, and cut a small piece of it. The best way to highlight a fret is to choose a color that contrasts with the rest of the fretboard. In this case the fretboard is Rosewood, which is dark in color, and the inlay is Maple, which is light in color. If the fretboard was a lighter wood, a piece of Walnut, Rosewood, or Ebony would make for a nice contrast. The point is to make the fret stand out and call attention to itself, which it cannot do if it is close to the same color as the rest of the fretboard.



Cut the piece to length (keeping the grain running in the same direction) and test fit the piece several times as more and more is sanded away. The fit needs to be perfect, otherwise the fret saw will not be able to re-cut the slots in the correct locations later on. The piece will also need to be thinned to a little more than 1/8", but not much thicker otherwise it will not bend well as it is pressed into the slot. Make any small adjustments to the length of the piece by sanding it against a flat surface with sandpaper laid on it, which will keep the piece even.

Once the piece fits perfectly without having to be hammered into position or falling out easily, it is ready to be glued in place. This can be done with regular Titebond glue, however the Rosewood may need to be leached first before gluing, to ensure the oils do not interfere with the adhesion.

Spread a thin layer of glue over the cavity, making sure to get a little on the walls as well, and then spread some on the piece being inlaid. Once both have had a smearing of glue, the piece can be placed on the fretboard and clamped. Make sure that the inlay piece is fully against the fretboard before leaving the neck to dry. If the inlay is not completely flat, there will be gaps in the joint, and an inlay that is meant to be seen, will look terrible to all who see it.

Once the piece has had a few hours to dry, or better overnight, remove the clamps and take a look at the piece. Check that there are no gaps between the lighter inlaid wood and the darker fretboard. If there are, they will need to be filled with a mixture of Rosewood dust and Titebond glue. This will fill the crack with a dark filler mixture, hiding it a little better than leaving the gap visible.

Begin the process of sanding the inlay level to the rest of the fretboard, which is easiest to accomplish by using a radius sanding block and sandpaper. Use the same block that was used on the rest of the fretboard to guarantee that it will be accurate, and concentrate the action over the new fret inlay. Start with 100 grit or 150 grit for the rough work, then switch to 220 grit for the final smoothing and blending.

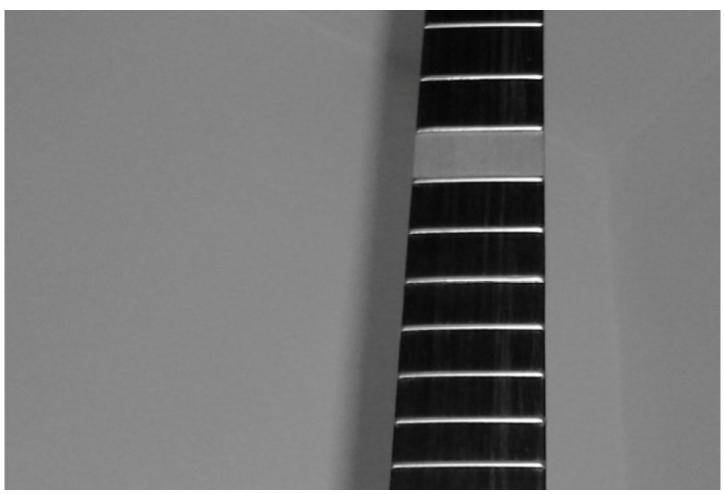
Once the top of the inlay has been sanded level, the sides will also need attention. Carefully bring these level with the rest of the fretboard, taking a little off at a time. These ends can be very easy to break,

especially if the grain runs in the same direction as the fretboard. It is a very real possibility that a piece can end up breaking off over the fretboard, which will cause a huge repair. Carefully go through this process, and the edges should sand down fine.

Since the inlay went completely over the old slots, the new ones will need to cut through only the inlay in order to be in the correct position. Set a square, a fence of some kind, or any other method of guiding the fret saw, and saw the two slots in their correct places. Use a depth stop to make sure they are deep enough but not too deep, and clear out all the saw dust to check the progress.

Looking at the cuts, there should be nothing but the inlay piece being cut, which can be verified before proceeding to the fretting stage. It will be difficult to completely eliminate any contact between the Rosewood edges and the saw, but this should be minimal.

Once the fret slots have been cut, the fretting can continue as though this were a completely normal neck. There will be no difference in the performance of the frets in this location, though a little added glue can provide some peace of mind if desired.



Take some extra time when making an inlay like this, because again it is the kind of inlay that draws attention from people looking at the guitar. If the very thing that draws their attention is done poorly, everyone who handles the guitar will know it was not done well, and all the interest will be lost.

This kind of inlay can be done all over the fretboard if desired, and it would be interesting to see a fretboard where every fret that normally

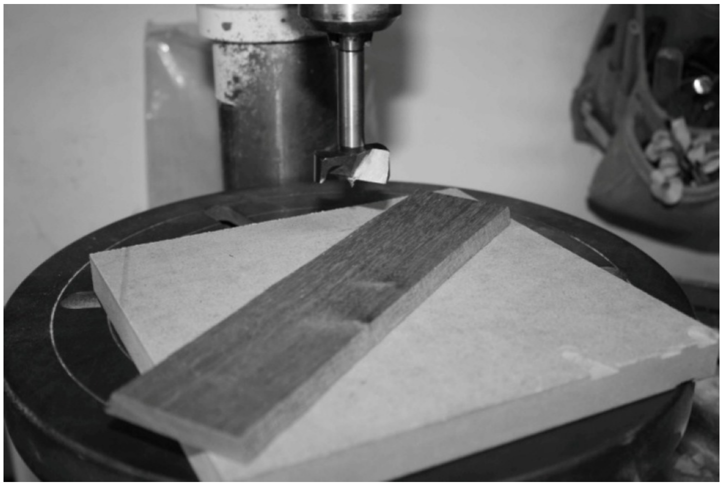
receives a fret dot were to have their boxes inlaid instead. It would be an interesting looking neck for sure, and probably a very easy neck for a player to use, because it would be completely obvious which fret was being played.

Also, a center dot or two can be inlaid into the plain fret box inlay, adding another layer of complexity to the instrument. This does not need to be terribly elaborate, and can be a simple dot of a darker species of wood.

GAP FILLING TECHNIQUE

Every now and again, no matter how experienced the guitar maker, the need to fill in a small gap arises. Typically, this is in the binding area, where lots of things have to go right in order to have a nice flush installation. Sometimes the binding strips can be glued without being pushed all the way down, resulting in a small gap between the binding ledge and the piece itself. When this happens, there are a few ways to deal with it, one of them being to fill the hole with wood dust and glue.

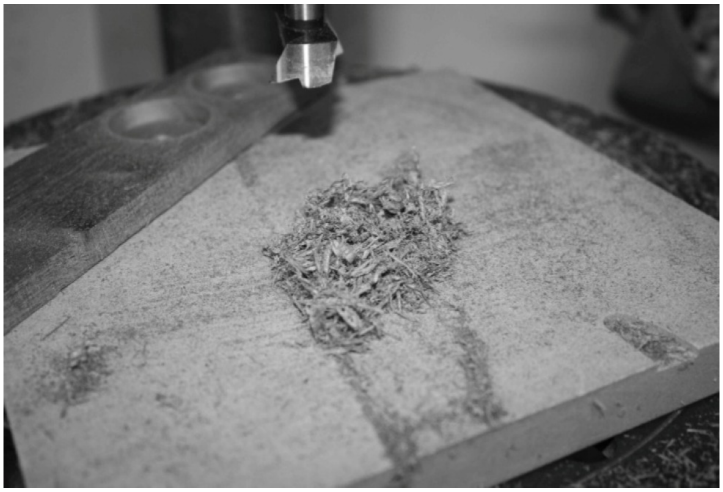
This technique works best with very thin gaps as seen in the picture above. Right in the center of the picture where the Mahogany meets the Maple binding strip, there is a small gap between the two pieces. If this guitar were finished as it looks right now, the finish would seep into the gap, and at an angle there would be a visible indentation. This would take away from the look of the guitar, so it needs to be filled.



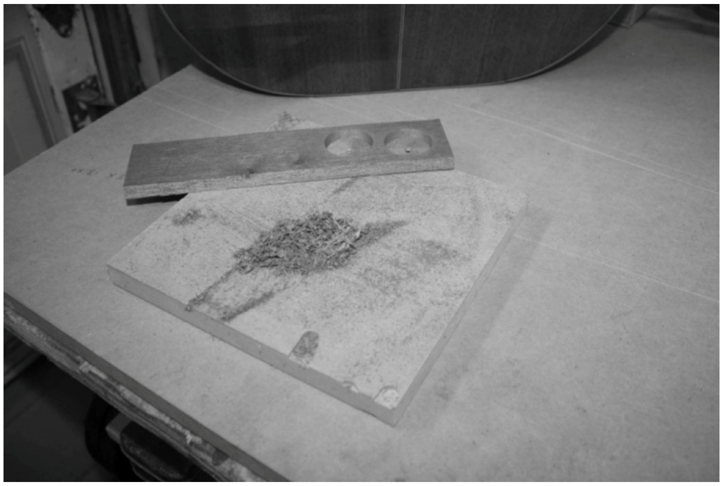
To prepare a identically color matched piece, some sawdust will be needed from the same species of wood. If available, use a cutoff from the exact same board used to make the part of the guitar being filled, because it will be as close as possible to the actual wood coloring. Typically these can be found in the scrap bin, as most of the cut off pieces should end up saved anyway.

Find a matching piece and bring it to the drill press. Be sure to use a vacuum or a compressor to remove all the dust from the table top, as well as from the small board placed under the mahogany in this case. The board is used to catch and keep most of the shavings that are about to be made, so both of them need to be clean before starting the process.

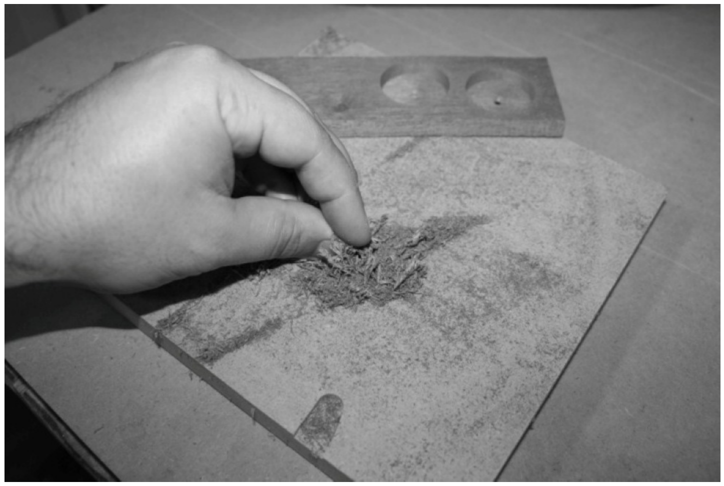
Using a large Forstner bit, drill several holes into the piece of matching wood, but do not drill so far as to hit the board underneath. The drilling needs to take place slowly, in order for most of the scraps to stay on the board. Also, advancing the bit a little slower encourages smaller and finer shavings to be made.



After a few holes have been made that go almost all the way through the piece, stop the drill and wait until the bit stops moving. Reach under with the piece of scrap and use it to gather up as much of the wood dust as possible. Scoot it from all over the board to near the center, which will make it easier to pick up and move for the next couple steps.



Bring the entire board setup from the drill press over to the workbench, which has also been cleaned off prior to this process.

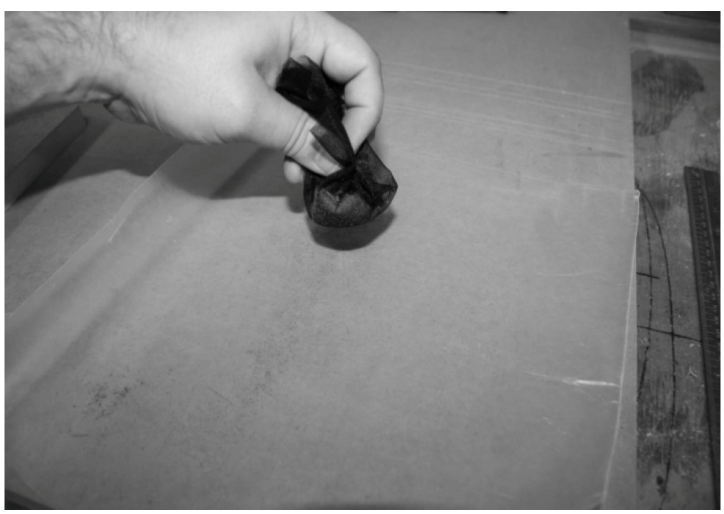


With the fingers, or by using the back of a screwdriver, grind up the pile for a few minutes, creating finer and finer shavings.

In order to separate the finer shavings from the larger pieces, a method of sifting the wood dust is used. The black piece of fabric in the pictures is a small section of no-see-um netting that is sold in camping stores, and places where people make their own backpacking gear. It is very thinly woven, and will only allow very small particles to pass through. It is used in tent making as the netting to keep out even the smallest of insects. This is the best way to really get the smallest particles isolated.

Lay the piece of no-see-um netting over a piece of wax paper, which will serve as a way to capture all the small particles as well as a place to mix them with glue later on.

Dump the entire contents of the larger board onto the netting, being careful to get all the pieces on the netting as opposed to next to it. If anything falls next to the netting, do not worry too much about it, as it will be removed before the process begins.

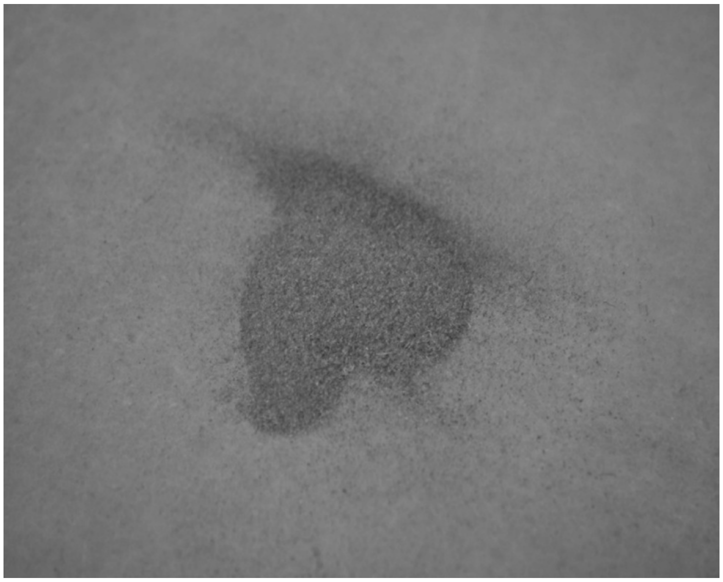


Wrap the ends of the mesh into a small ball that holds all the wood dust in the center. This will look similar to making a French polishing rubber from a ball of wool and a cotton wrapping.

Once the mesh has been gathered, blow off any remaining particles on the wax paper before moving on to the next few steps. It is very important that no other particles are on the wax paper when the sifting begins, because they can mix and contaminate the pile.

Vigorously shake the little bag of sanding dust, and tap it with the fingers for several minutes, while holding it over the wax paper. A slow and steady stream of very fine shavings should begin to emerge, making a little pile.

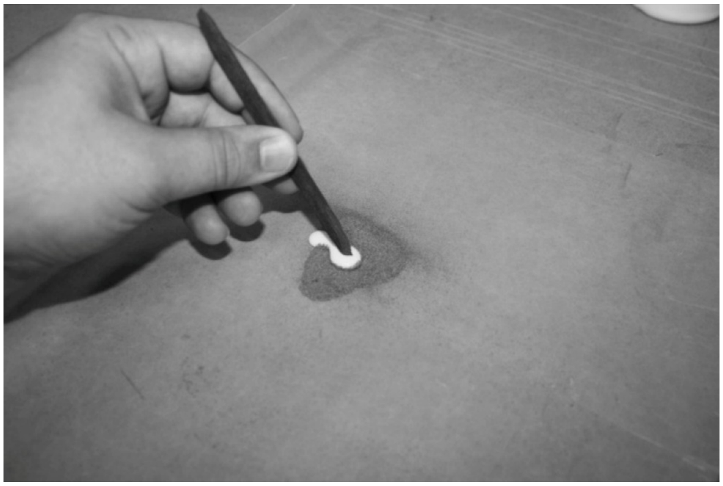
Work the end of the mesh between the fingers to encourage the shavings to fall free. If the mesh is merely shaken, not very much will come out at all, which is not a good thing. Rub the mesh where the dust is trapped, and in a couple minutes there will be a large enough pile to mix with some glue and make a filler material with.



After a few minutes, the rate at which the bag dispenses sanding dust will slow down considerably, signaling that everything usable has been sifted onto the paper. Throw the mesh and its contents away immediately, and wipe off the hands with a towel before going back to the pile of sawdust.

Lift up the edges of the wax paper one at a time, gathering the contents into a small pile in the center of the sheet. There should be enough to fill a shot glass about 1/8 of the way, which will be plenty for several fills around the guitar.

Pour a small dab of glue into the center of the pile, and begin to mix it with a small piece of wood broken from the end of a binding strip.



It will be a challenge to mix the glue, because it will want to roll off the sanding dust rather than mix with it.

Keep working at it until a very thick paste is created, one that has the consistency of glue that is about to dry. There should be far more dust in the mixture than glue, and it should look like it may dry out before it gets to the guitar. A little experimentation will be needed as time goes on to get the precise mixture down, however this technique is very forgiving. If a fill goes wrong, it can simply be sanded out and filled again. This process

can be repeated a hundred times if necessary, and will eventually result in a good looking fill.

A piece of binding strip that has been cut to a point is the best method of applying the mixture to the edge of the guitar. First, make sure the gap is free from any other sawdust or contaminants by blowing it out or using a dry paint brush to clear it out. The deeper the fill can be placed, the better it will adhere over time.

Gather a small amount of filler material on the edge of the stick, and bring it over to the gap in the guitar. Begin pressing it into the gap with the sharpened end, going back for more mixture from the workbench as needed.

Keep applying the mixture, ensuring that the gap itself has plenty inside the opening. After the opening has been filled, apply a little more over the top, which will protect the filler material inside the gap, and encourage it to harden inside. Try not to get too much on the surrounding areas, as the glue can get into the pores of the wood and discolor them a little bit. Since this area will be scraped and sanded after the fill has dried, a little overhang from the mixture will not be a huge issue. Do not however just let it go anywhere, try and concentrate on the areas needing the fill.

Move around the entire guitar in this manner, filling any holes that are adjacent to the same species of wood, pressing the mixture deep into the gaps. If the mixture gets too hard, scrape the hard parts away and add some more glue to the dust pile. Mix it up the same way, and apply the new mixture just like the old.

Leave the slurry several hours to dry after it has been applied to the guitar. The mixture itself will begin to take on a lighter coloring when it dries, and will need a longer time to ensure the material inside the gap fully dries as well. If worried about the drying, leave the guitar overnight in a room temperature place, which will ensure proper drying.

When the fill is dry, it will look like the picture above, and will be like a small piece of cement stuck to the side of the guitar. It will be very hard to remove with a scraper blade alone, which is why the sanding stick is brought out first to remove all the really rough spots.

A sanding stick is simply a piece of wood with a piece of a sanding belt glued to it. When made from the actual belt that goes on a belt sander, these sticks last practically forever and really remove material. Instructions for these can be found in chapter two, and they take only a few minutes to make.

Start with a sanding stick, or a piece of 100 grit paper backed by a block. Carefully remove as much of the residue as possible, trying not to contact the edge of the guitar any more than necessary. The heavy abrasive

belt can really remove material, and it can cut through binding strips and down to the wood very quickly.

The reason the larger and more three dimensional pieces of the filler material are removed before scraping, is because the scraper has a harder time with a surface that is really rough. Once a little flat area is created, the scraper removes material very well, and will level out the fill quickly.

Working on the sides of the guitar can sometimes be tricky with a scraper, because both hands are needed to operate it. Try pulling the scraper towards the body while the guitar presses into the chest. This way the body is held in place as well as allowing for both hands to be used on the scraper.

Change directions from time to time while scraping, and keep going until all the darker colored material has been removed, and the surface flat and smooth. A very sharp scraper will make very quick work of leveling the fills, and once they are gone it will be very hard to tell that anything was done to the area.

The picture above shows the same area after the fill has been scraped off and the surrounding area scraped level. It was a very thin gap to begin with, and now there is not any gap at all. The filler material has been glued into the holes so solidly that it will not come out, and the color matches so perfectly that it is basically invisible. It will even take a finish without any problems because there was far more wood in the filler material than there was glue.

The process described here does require quite a bit of effort and attention to detail. Even so, the results are well worth the extra time. A guitar is something that will be played and enjoyed for decades, and a few extra minutes to ensure it is as beautiful as it can be are well worth it.

Project Notes:

As different species of wood are processed in the shop, make a habit of keeping a small amount of the dust in sealed sandwich bags. The planer is a great place to get these shavings, and bagging them up and saving them is easy.

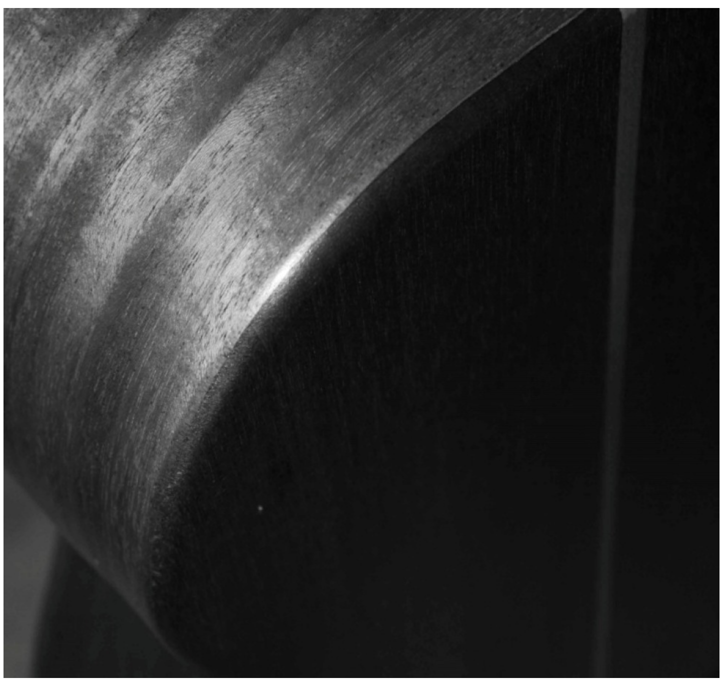
Label each bag with the species, and save them in a dust free location of the shop. If a fill of a certain color or from a certain species is needed, select the proper bag of shavings and begin the process from the point where they are crushed into a fine dust.

Having a place where a reserve of shavings are kept ensures that there will be some filler material that can be made to fix any problem that the guitar might have. No matter the color or the species, any small gaps can be filled this way.

ROUNDING OVER THE EDGES

When making the first guitar, it is always best to attempt a design that is within the range of possibility for someone new at guitar making. There should be some challenges absolutely, however a person should not try and create their master work on the very first try.

There will be many guitars made in a life that is filled with instrument making as a hobby, and it is better to execute a basic design well than barely limp through a complex design. One of the most daunting tasks for the first time guitar maker is installing binding and purfling, and by omitting this, many other aspects of guitar making can be more thoroughly practiced on the first instrument.

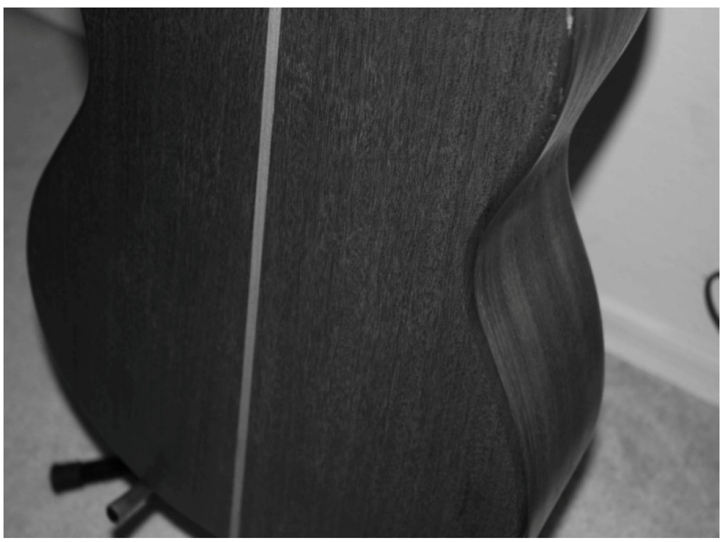


There are no rules for guitar making that are written stone, especially when it comes to binding and embellishing an instrument. The binding takes more time than almost any other process on the build, and can really be stressful for the beginning luthier. By deleting the binding, the

stress is removed, however something still needs to be done to the edges to trim them up.

A simple router with a round over bit can be used to put a small radius on the soundbox, which will trim the edges nicely as well as make the instrument look better. The rounding can be done with a router as already mentioned, or carefully by hand.

The process of filing and sanding the edges by hand to reduce the flat edge of the soundboard is not a quick undertaking, though reducing the radius that will be applied can make the job a little easier. With a router, a larger radius is created because the machine is doing the work. By hand, a smaller radius should be created, which will trim out the edges as well as make the lack of binding look intentional.



When using the router, make a series of shallow test cuts on the back side of the body, in order to sneak up on the correct radius. The idea is to get as large of a radius as possible, without cutting through to the kerfing. Do not radius the couple inches on the soundboard where the neck will attach, because it will look odd. Leave those few inches flat.

Once the proper depth is found, use the router and the round over bit to put the same radius on both plates of the guitar, following the profile of the sides. A larger radius will look more intentional than a smaller radius, and will have a look that is distinct from many guitars in production right now.

After the router has been used to radius both faces, switch to 220 grit sandpaper to fix any areas where the router may have dug in too far or not far enough. Once the area around the rim is even and smooth, the guitar is ready for the neck to be attached as well as for the first coats of finish. Pay extra attention to the edges when using the sandpaper, so the kerfing is not exposed.

WOODWORKING TIPS/TRICKS

Here is a collection of small tips and tricks that will help make woodworking and guitar making easier and more enjoyable. They come from years of making guitars and other wooden projects, and will help a new builder to avoid pitfalls.

Simple things like sanding properly, keeping an organized shop, and using sharp tools are not as simple in the beginning. Sometimes it takes a while to learn the right way of doing things, and many times it is at the cost of several projects that could have been better.

These tips and tricks are to help ensure that every guitar comes out as planned, without too many surprises along the way. There will always be some in the beginning, but hopefully the following pages will reduce the amount and severity.

Sanding With The Grain

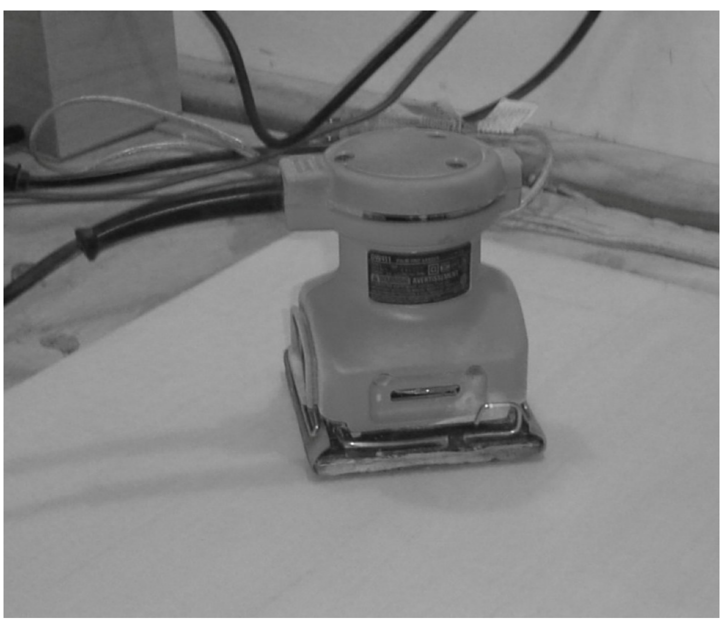
When sanding a piece of wood, it is really not that big of a deal in which direction the wood is sanded at first. The common knowledge is to sand with the grain, however there is not a single palm sander in the world that does this. Most power sanders make come variation of a circular pattern, and yet they still leave a good surface behind. There are some times

when sanding with the grain is important, though it is not required all the time.

When rough sanding, use a power sander or sanding block and go in any direction needed to get the bulk of the material smoothed out. If the bulk has been reduced or removed, switch to a finer grit and sand again to remove all the scratches left by the previous grit. Repeat this until the wood has been sanded to 220 grit.

Once the final grit has been reached, it is then a good practice to switch to a motion that follows the grain to eliminate the last few sanding marks. Every bit of sanding up to this point means nothing, because the last bit of sanding will determine what the final surface will look like. The final few passes with the grain will hide the last of the sanding marks, by making them all run in the same direction as the wood grain. The scratches are still there, they are just hiding from view.

If using a power sander, work to 220 grit, then use very light pressure to go over the entire surface again. This will eliminate most sanding marks, which can then be completely erased by a quick hand sanding with the grain.



Let The Sander Do The Work

As if power sanding itself did not make sanding a piece of wood so much easier and so much faster, some people still think it is a good idea

to help out the sander by pressing the unit as hard as they can against the wood. Not only is this a bad idea, but it actually makes the sanding process take longer instead of speeding it up.

A power sander can smooth out a piece of wood ten times as fast as sanding by hand, maybe even faster. When it is pressed hard into the surface of the wood, the small particles of grit also dig into the wood, causing deep scratches. These marks would not be made if the sander was used with low force, not far exceeding the weight of the sander itself and the hand resting on it. The sander will take a little longer to cut through an area, but it will also not leave deep scratches that will need to be removed later.

When using a power sander, rest the hand on the top of it and use the weight of the sander and the weight of the hand as the only pressure. Allow the sander to move freely from place to place smoothing out the surface, and look at the difference in the surface at the end. A sander that was pressed very hard will not leave as smooth of a surface as one used with less pressure. The board where the sander was allowed to work without additional resistance will be a smoother board, with hardly any sanding marks to be removed at all. The next finer grit will also have to work less, and so on through each and every grit level. Also, the arm will not get tired as quickly, because it will not be a workout to sand the guitar.

Try using less pressure on the next back or top being sanded, and see how much faster the process works than before. Once the smoother surface is felt and seen, it will be easy to make the change.

Keep An Organized Shop

Having a place for all the tools used in a shop, and returning them to that same place at the end of the day, will make the process of guitar making much more smooth and less frustrating. Spending five minutes looking for a drill bit, then another ten minutes looking for the chuck key, and finally another five minutes connecting the power to the drill press wastes time and effort. Plus, the frustration of digging through the entire shop looking for something makes further messes. This frustration can be carried over to the project, where it may cause accidents and ruined pieces of wood.

Keeping things in their place makes it easier to find tools when they are needed. A good way to be organized is to use a large peg board on the wall, where tools can be hung up when they are not being used. This will serve two functions in the shop, one for organization and the other for storage.

A peg board makes use of a wall in the shop, where storing many tools can be done without taking up very much shop space. A large tool box would require space on the floor, making the shop a little smaller. A peg board on the wall uses dead space for storage instead of taking up room with a rolling tool chest.

The second benefit of using peg board is that all the tools that would be used in guitar making are readily visible, and easy to find. Digging through tool boxes and drawers takes time, and can be a pain sometimes to find the needed tool. Being able to scan the wall and find the exact tool quickly means more time will be spent working, and less time looking around for tools.

Organize the peg board by types of tools, keeping all screwdrivers near each other, and all carving tools and chisels near each other. Clamps can have their own space together, and they will sit easily on long pegs. Templates can be hung together in another section for easy use, especially large full size templates.

Small baskets can be purchased that hang from the peg board and hold smaller items that have a hard time being hung otherwise. Remember not to over fill the baskets, otherwise the tools will not easily be able to be found. There are also parts bins that have small drawers which are great for machine screws, bridge pins, saddle blanks, and any other small guitar related items.

Cam clamps can be kept on the peg board with two long pegs placed a few inches apart. Open each clamp all the way and stack them facing down, hanging over both pegs. Taking them off and returning them to the peg board is very easy, making it more likely that they will be returned there afterwards.

A smaller peg board can also be hung over the workbench for tools that are used more often, or tools that are exclusively used at the bench. This only needs to be 2' x 4' to have plenty of space for holding any and all the tools that are needed to be within quick reach.

Keeping organized also ensures that more of the time spent in the shop is actually spent on making the project. If a 5 minute peg veneer glue up takes 30 minutes because the clamps were missing and the glue was hard to find, that is 25 wasted minutes that could have been spent on the guitar. Especially in times when life is busy, and there are few hours to work on the guitar in a week, having things organized can help to make the most out of the time that is had.

Woodworking and guitar making should be very peaceful and relaxing activities. When frustration enters the shop, the results are not good. Stress and frustration lead to incorrect measurements, forgetting details, and overall makes it difficult to make a wooden project well. Also, frustration leads to poor decision making, which can result in lost fingers or other injuries from shop equipment.

Take the time to clean up after each work day, and make a habit of putting tools away right after they are used. There will still be a little mess to clean up in the end, however it will not be as bad as if the shop were cleaned once a week.

Using Sharp Tools

When using cutting tools, like chisels, planes, and scrapers, keeping them very sharp is the most important factor that determines how well they work, and how frustrating the job is.

The difference between carving wood with a sharp chisel or a dull chisel, is the difference between carving with a light saber or a butter knife. A very sharp chisel will go through wood very easily, and remove it cleanly. A dull chisel will have to be fought with and could potentially lead to a dangerous situation.

Make a habit of setting aside a little time to sharpen often used tools all at once. Most of the time the stones and compounds being used to sharpen one tool can be used on all of them, so while the materials are out, just do them all. It should take no longer than an hour to sharpen several chisels, a couple plane irons, and to change the disposable blades on hobby knives. Scrapers can be left for when they are used, because they require sharpening so often that the burnisher is usually very close at hand.

When carving the braces, the sharper the chisel the easier it will be to shape the wood. There is a great deal of carving being done when shaping guitar top braces, and a worn out chisel can double the time it takes to complete the job. A dull chisel can also cause the tool to become stuck in the wood, or slip off and gouge the top from underneath. Though under the top will never be seen by anyone except perhaps a repair person many years down the line, it is still good practice to keep it as clean as possible.

A hand plane can be a very important and often used tool, as long as the iron has been sharpened well. So often hand tools are cast aside

because they become dull, and do not seem to work as well anymore. The older style of tools require a little more maintenance than newer tools, however they will work just as well. A good sharp hand plane is the absolute best tool for tapering the sides of the guitar while they are in the mold. A sharp plane reduces the side height near the neck quickly, and leaves a very clean edge behind.

If hand tools are sharpened often, they will end up being used more often, and they will perform better too. Sharper tools do what the user wants them to do, reducing the chance for accidents and injuries. Be sure to take the time to sharpen all edged tools regularly.

Keeping A Scrap Bin

As guitars are made and pieces are cut, smaller off cuts and scraps will need a place to be saved if they are to be used again. Most guitar makers and wood workers have dedicated areas for scrap wood, and it is normally stored by size. Scraps are great when a finish needs to be tested, a caul needs to be made, or a sacrificial piece of wood is needed on the drill press.

Having a place for scraps ensures that they will not end up being thrown out, or piled up in a corner somewhere. A five gallon bucket from a home improvement store is a good sized and portable unit that can hold smaller scraps and cutoffs. The bench itself can have a shelf dedicated to storing medium sized pieces of wood that might be used for some other part of the guitar like peg head veneers, bridges, and fretboards. Even cutoffs

from the soundboard and the back plate can be saved for finish testing, or for repairing and filling a crack.

The objective is to save and organize as much of the medium and small scraps as possible, but to throw away anything that is too small to make several fret dots from. The very small pieces that are smaller than a guitar pick really do not have a ton if use. They can be saved of course if that is desired, however if every single scrap is saved there will be no room for woodworking anymore.

The cutoffs and extra pieces that are used for bridges, fretboards, and veneers will save money on wood that might have had to be bought, and help keep the expense of guitar making a little lower.

Signing and Dating The Work

One of the most important non-construction related items to address on the guitar, is to write several pieces of information on the inside. This not only catalogs the information for the future, it also leaves a personal touch on the guitar, that no mass produced guitar will have.

The best place to sign is under the top, between the lower left leg of the x-brace and the lower face brace. This area is completely hidden from view when looking in from the soundhole, and would only be seen if an inspection mirror were placed inside. It is most likely that this space will go un-noticed for decades. The information will always be there though, should someone stumble on this guitar in a flea market half the country away, and wish to know who made it. The label inside the soundhole can

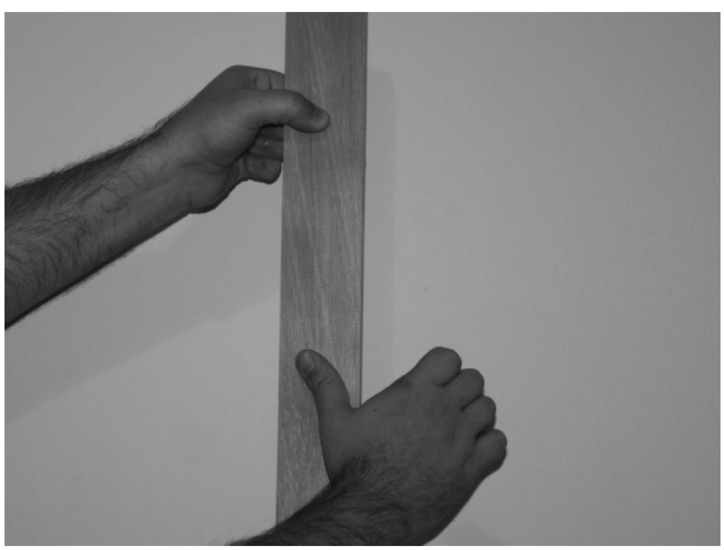
come off over the years, especially if the guitar was mistreated or abused, and the information written inside the guitar may be the only record left of its creation. Having a backup to the label is important.

Use a sharpie to write the details, and do not press hard or linger very long while writing. Make the marks light and quick, so that gallons of ink are not soaked up by the top and transferred to the other side, where they can be seen. It is wise to record the model of guitar, the number of this model that have been made, the date it was made, the name of the guitar company or private luthier who made it, and finally the signature of the builder.

If concerned about bleeding through the top with a marker and being able to see the signature from the outside, a pencil can also be used to fill in this information. It will be important to take one additional step afterwards though.

Since a pencil will wear away easily, it is important to trap the information under a layer of clear lacquer or varnish after it has been written. It is best to use an aerosol can for this application, as wiping varnish or oil on top of the pencil marks will likely smear them. If a more traditional product than spray lacquer is required, shellac is available in a spray can, and can be applied over the pencil marks.

When applying the shellac or lacquer, first apply a fine mist and allow that to dry. Then, apply another fine mist, and continue repeating this until a thin layer has built up. This should only require about three of these light sprayings to be strong enough.



Tapping the Wood Often

The best way to learn how to use the sound that wood makes to help build better guitars, is to tap each piece often and listen to the sound it makes. Master guitar makers really get acquainted with their building materials, and this includes tapping, bending, pushing, and applying pressure to the pieces, just to feel and hear how they respond.

In order to be able to use sound as a factor for making guitars, many will need to be made, and they will all need to be tapped on and listened to very often. Especially when making the top, tap it often and listen to how the sound changes. These sound differences may not be understood at first, and the subtle changes in the tone of the top as it is carved might not even be heard at all. This is fine, the important thing is to keep on tapping the piece of wood, and keep on listening.

Tapping and understanding what is heard is almost like wine or beer tasting. To the newer person involved, they really all taste about the same, however to the expert, there are large differences. The same could be said about cigars. Not really being a cigar smoker, it is hard to understand how one could really be that much different than another, but people who do smoke more often can tell the difference. Listening to wood will be the same in the beginning, an almost pointless exercise, but over time the sense will develop and the subtle changes will be heard as loudly as anything else.

There will be no certain sound to listen for that will be the cue to stop carving, there will be however a similarity of sound among completed instruments that share good sound quality. Listening to the sound helps teach the builder when the piece itself is done being worked on, because each piece will be a little different.

Do not believe for a second that the sound of each piece is more important than getting the structure and joints correct, or that if a person can never really hear the sound changes, that they cannot become a great guitar maker. All of these are completely false statements. There are makers who place way too much emphasis on the tap tone, and great guitars can still be made without really understanding this part.

It is important to listen to the wood, learn to use more senses than just sight and feel to make the guitar, and use the sound of the wood to help gather a better understanding of the material.

Veneer Variety Pack

A great source for inexpensive veneer that can be used in many places on the guitar is a veneer variety pack. These are often sold as wood identification tools, where a single piece of veneer from 50 or more species will be present in the package.

Veneer pieces in different colors and lengths are used in guitar making for many different tasks, including making custom pick guards and for veneered peg heads. These pieces come in the perfect size for both, and can easily be used either way.

The more interesting pieces can be sorted out to be used as pick guards and peg head veneers, while the less interesting pieces can be used underneath the better looking ones. The Oaks, Maples, Pines, and other basic looking species can be used under something like Myrtle or Walnut Burl, to make a blank that can be cut into a pick guard. Also, a three veneer sandwich can be made that alternates light, dark, light and glued on the peg head face. Now the edges will have a nice decoration around them, as well as making the headstock look good.

These packs are not very expensive for what they can turn into in the shop, and they will have so many pieces of veneer that they will last a long time.

Weights As Clamps

Gym weights are very useful in the shop, and can be pressed into service in a number of interesting ways. The picture above shows a couple ten pound weights being used to hold down a wooden caul, while book matching a guitar top. This frees up clamps that can now be used for other things, and is just as effective.

When looking for gym weights, most of the time they will be buried somewhere in the garage, as a distant memory of a healthier time. The smaller weights will be perfect for light clamping duties, and gym weights ranging anywhere from 2-1/2 Lbs. to 25 Lbs. are ideal. Dowels can be drilled into the legs of the bench where the weights can be hung for easy reach, or they can be stacked under the bench and out of the way.

If there are no gym weights available in the house, the next best place to look are second hand stores and online listings. Craigslist is full of quitters, and they are usually willing to sell their stuff for far less than retail. Taking a look at online resources like that will aid in purchasing the weights on a discount, rather than paying far more in the sporting goods stores.

Gym weights can be used any time light but effective clamping pressure is needed, such as in the case of holding down the center joint in a book matching press, gluing cork to wood for clamp faces, weighing down a veneer press, and gluing the center reinforcement on the back of the guitar. Just having them around in the shop will encourage thought, and many more uses will be figured out as each guitar is built. Remember to check online and in the second hand stores before buying anything in a retail store for full price. When in doubt, several 5 Lb. weights will work

wonderfully, and more can always be added if more clamping pressure is needed.

Making Picks From Veneer

In the same way that pick guards are made from three sheets of veneer, guitar picks can also be made. The process is the same, except a new pick will be needed to trace onto the veneer sandwich instead of a pick guard shape.

Trace as many picks as possible onto the veneer sandwich, which is described in chapter five, and cut them out with the band saw and a very thin blade. Sand the edges and round them a tiny bit, and finish them with a light coating of boiled linseed oil or Tru-Oil.

Wood Burning (Pyrography)

The wood burning tool is a vastly underused piece of equipment that can bring exceptional artistry to the acoustic guitar. These can be simple tools that are very inexpensive, or they can be high end professional tools that a seasoned wood burner would use. Either way, adding burned accents to the guitar is a great way to embellish it.

If new at wood burning, select an inexpensive tool that will be fine for learning the basics, before progressing to a higher end tool. The basic tools are a little harder to work with, but the trade off is they do not cost very much. A higher end tool can be had for a few hundred dollars, and will make the learning process go much easier.

There are several areas on the guitar than can be enhanced by wood burning. The rim can have a fine vine or floral image burned into the wood on either the top or the back. The sides, especially in the shoulder area, look great with a little burning, as well as the heel of the neck. The back of the guitar is a plain canvas to an artistic guitar maker, and can be covered with a large image, or a combination of inlay and wood burning like the picture in the left hand column.

Play A While Before Judging

When a guitar is strung up for the first time, it is very uncomfortable for the wood, and there are tensions that will take time to settle. In the first several hours of a guitar being made, the sound will

undergo many dramatic changes as the wooden pieces become acquainted with one another. It is important to play a guitar for several hours, and allow this brief braking in period before judging the guitar based on tone, warmth, and resonance.

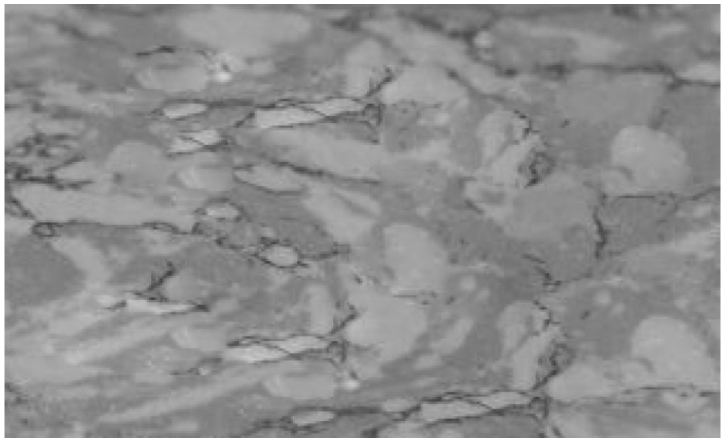
The reason older instruments sound better than younger instruments, is that they have been played far more than a new instrument. The pieces of wood have had ages to settle and get used to vibrating frequently. The old instrument has a quality to it that cannot be understood until played, and playing the instrument is the only thing that will make this change happen.

There is a very good reason why a guitar with a fifty year old sound cannot be built today. It is because it is impossible to build an instrument that is already fifty years old. Older instruments have been played more, and the sound quality reflects this lifetime of playing. The only way to add years to a guitar is to play it, which means that a guitar cannot be judged right out of the shop.

Play the guitar for an hour or so every day for a couple weeks. Trade out the guitar being played at the moment for the new one, and make it the daily player for a while. As the days and weeks roll by, the sound will deepen, the tone will emerge, and the sound quality will improve greatly.

If playing the guitar this much in the beginning sounds like it will be hard to do, consider investing in a automatic strumming device for the guitar. This is a small electronic device that "plays" the instrument for as long as it is plugged in and attached to the guitar. This will get much of the initial playing-in out of the way, without actually having to devote hours to the task.

Once the guitar has been broken in this way, the sound quality can be looked at and analyzed for ways to be improved in the next instrument.



Tru-Stone Inlays

Tru-Stone is a man made material consisting of crushed up colored rock and epoxy, which is hardened into a piece that has the look of natural stone but the workability of a very hard wood. These blanks come in many different sizes and colors, each one with a certain pattern. Any one of these blocks can be used for inlaying on the guitar, and will have the look of fine marble.

The blanks can be sourced most easily through an online pen turning supply house, where they will have several different colors, designs, and sizes available. The wine bottle stopper size is probably the best for making inlay blanks from. It can be cut into 1/8" sheets, and then have individual inlays cut from the pieces.

For making simple fret dots with a plug cutter, the pen blank size is going to be the best. One face can be covered with dots from the plug cutter, then a saw can be used on that same face, freeing the plugs. Saw slowly and carefully with a band saw or hack saw, which will help keep the blank from breaking apart.

Take Thinner Passes

Whether it is with the planer, jointer, router, or rotary tool, taking thinner passes instead of one really deep pass will make the work come out much better. Just because the router bit can stick out past the base plate two inches, does not mean it was designed to be used that way.

Especially when using a thickness planer, taking several very thin passes instead of a few deeper ones will really increase the planers performance. A very thin pass hardly removes any wood, which also hardly digs into the surface very far. Less digging into the surface means less resistance to the blades, and less a chance of tearing out a chunk of wood.

If the planer is used in passes of 1/64" or less, it can almost be used as a thickness sander, because it can make the pieces of wood extremely thin.

The same goes for the jointer. It is better to make five or six passes at a very shallow depth, than to make one or two very deep passes. Adjust the jointer table so that the bare minimum is being removed, and it will leave a cleaner surface behind as well as reduce tear out.

The router and the rotary tool are similar in the sense that they both remove wood with a spinning bit, the router being the larger and the more capable of the two. When making pockets for electronics, truss rod slots, and saddle slots, make a couple passes at a shallower depth, and increase the depth with each successful pass.

The router is a very powerful tool, which is why it will tend to drag and pull when too much of the cutter is used. It is very difficult to control a router when more than 1/4" of the bit is cutting the wood, and the

chances of a catch are greatly increased passed that. Any depth that looks large, dissect into a few stages, and route each one separately.

Keep The Bench Clean

When carving the soft Spruce top, or carving any of the plates, the bench needs to be immaculately clean. A small piece of wood shaving from a harder species than Spruce (of which almost anything other than top woods will be) can dent the top. This may be able to be sanded out, or it may not, which will cause problems with the look of the final guitar.

Since carving the braces requires pressure from the chisel that is transmitted into the bench top, keeping it clean will ensure that there is no damage done to the Spruce, and make the final sanding go much easier later on.

Vacuum the top of the bench prior to carving the braces, and use a flat work board like the one described in chapter two. This way the delicate top wood will not become damaged during carving.

Carve With The Bevel Down

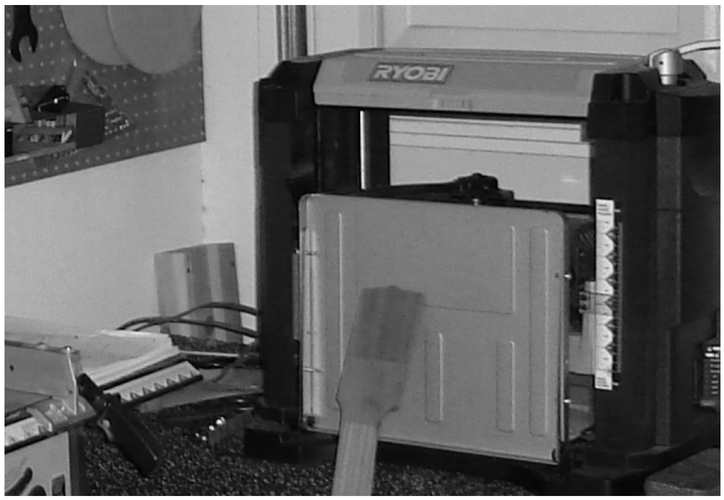
Carving the braces can be a challenge at first, until many tops have been carved and the skill has been mastered. A tip for making the process easier is to carve with the bevel of the chisel against the braces, rather than with the flat of the chisel. This allows for several changes in carving style, all of which make the process easier, and more enjoyable.

When carving with the bevel down, the chisel can be held at more of an upright angle, which allows it to get into tighter spaces easier than before. Many times the handle of the chisel will get in the way if carving with the flat down, because to get a shallower cut, the tool needs to be laid down farther.

There are some instances when the chisel cannot be laid down far enough to make the cut, and in fact there are special curved chisels made to alleviate this problem. Using the bevel side down, the most shallow of shavings can be made, and done so without the need to buy another tool.

Finally, when carving the scallops on the ends of the braces, having the bevel down allows the tool to be worked almost in a scooping motion, where a curved piece of wood can easily be removed from the brace ends. Start by plunging into the wood at the top where the scallop will begin on the brace. In one motion that is connected to the plunge, bend back the handle of the chisel as it is pushed forwards. This will make a cut that is shaped like a quarter circle where the chisel entered, flattening out as the bulk of the waste wood is removed.

Again, the chisel is held at around 50 degrees above the bench, pushed downwards, and at the same time the handle is allowed to tip back towards the bench, never stopping the cut. The entire scallop can be done this way, which is a much easier process.



Planing The Right Direction

A thickness planer and a jointer will work better when the wood is fed through in one direction more than the other. It may not be immediately noticeable which direction will work better until it is tried, but running the wood with the grain will be far better than running it against the grain.

It is difficult to tell by looking at a piece sometimes which way the grain runs, though this will come with time and experience in woodworking and planing. The knives in the planer will work best when the grain of the wood is fed with the rotation of the knives instead of against it. This will be very evident as soon as the piece is fed through the planer.

Those who have used the planer for a while will inevitably discover that sometimes the piece that is ran through is much louder and more crunchy sounding than normal. This is a dead giveaway that the wood is being fed against the grain, where the blades are almost trying to lift the wood out rather than cleanly slice it off. Rotating the wood so the same face is hitting the knives, but the other end is being fed first, the sound will reduce back to normal, and the sound the blades make will be more pleasant.

Make sure to figure out the best direction of feed within the first couple passes, making them as light as possible. It will be far harder to make this adjustment later, when the wood is so thin that it can be destroyed by feeding it incorrectly.

Clear Plastic Top Protector

In most hardware stores there is a section that sells large and small pieces of clear plastic, that can be used to make templates out of. They can also be used to make small plates that can protect the top and other areas during the construction process. It is terrible to be working on the frets that overhang the body, slip with the file, and gouge the top. While trying to dress up something minor, a major problem can be created.

One of these clear plastic sheets can be cut into smaller rectangles and placed over the area close to where work is being done. This will protect the area, and reduce the chances of an unnecessary repair to the guitar. A place where this is very important is on the top of the guitar, since the wood is so soft.

When working on the top of the guitar, be it on the bridge, or on the fretboard overhang, protecting the top is crucial. For example, if the neck angle was not calculated correctly, resulting in a bridge that is too high, sometimes the bridge itself will need to be planed down. This is a simple repair involving a block plane and the careful removal of some of the top of the bridge, effectively lowering it. If the top is not protected during this process, the plane can come off the bridge and gouge the

soundboard. This will cause a larger problem than the high bridge, since a gouge is not as easy to repair, and cannot simply be planed down a little.

These plastic sheets can be taped down in areas where there is a chance for unintentional contact, and if it happens, the sheet will take all of the damage.

Look in the hardware store next time and pick up one of these in a 1' x 1' size, which is large enough to tackle most jobs and can still be cut down for smaller jobs. Some luthiers actually make a cutout that can cover the entire soundboard, and is in the same curved shape. There is a notch for the fretboard and bridge to fit inside, which leaves the piece flat on the soundboard, and in this way they completely protect it.

Use a Plane on An Angle

Planes, chisels, and other edged hand tools are a little tricky to get familiar with at first, but become an essential part of the guitar making process over the years. A trick to using a plane that they should write clearly on the box, is not to use it the way it looks like it should be used. A plane works best when used on an angle, and so do chisels.

The plane looks like it should be driven forward in a straight line, parallel to the direction of the wood, which will remove material. This is the way most people use their plane in the beginning, which tends to cause problems.

First of all, the blade is being used in a prying or chiseling fashion rather than a slicing or cutting fashion, which causes it to be hard to

push through the wood. This causes the user to push harder, which usually results in the plane taking a far larger chunk out of the wood than originally desired. This frustrates the user completely, who leaves the plane in its box because it does not work or it is a bad tool. A notion that is completely untrue on both accounts.

When using the plane, hold it at a 45 degree angle to the direction of travel, using the blade as more of an angled slicer, and it will work much better than going completely straight. The blade encounters wood differently, and can use the blade more efficiently, which cuts more instead of prying, and in the end leaves a finer surface.

Try this the next time the plane needs to be used on a brace, or to taper the back sides. Instead of running the plane straight, angle it about 45 degrees off of straight, and push it forward, allowing the wood to run through the blade. It will slice well, make cleaner cuts, and be far less frustrating to use.

Google It

Many times when tools are frustrating, and not working the way they are supposed to, it is one of two things. The tool needs sharpening, or the user needs sharpening. In my experience, most of the time it is the user that needs the lessons, and in reality the tool works just as it should.

With the internet being as prevalent as it is in our society, and more and more stuff being posted every day, there is literally no reason why any woodworker or guitar maker should wonder about how to use a tool

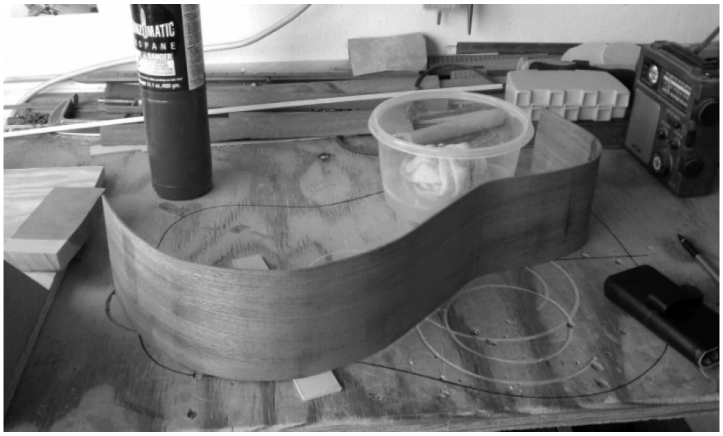
anymore. There are websites dedicated to any and every tool ever made, and filled with people who are willing to teach the techniques involved completely for free.

When purchasing a new tool, spend some time doing research about it, and learning how to use it virtually before actually setting any hands on it. This is important for a couple reasons, the first of which is eliminating any tool damaging mistakes that rookies may make, and the second is that a tool used properly works better. A perfectly fine tool that would be a great addition to the shop may accidentally end up on the shelf for a very long time if it is not used properly, and the results were not what they should have been.

If struggling with a tool, go to the internet browser on a computer, and type www.google.com into the address bar. Once on the Google website, type "how to use a X", with X being the tool in question. In less than a blink of an eye, Google will return millions of search results, all sorted with the most relevant on the top. Read the blue text, which are the headlines so to speak, and find one that matches the question. Read the information and try the techniques in the shop.

Also, YouTube is another fantastic resource also operated by Google, where people will demonstrate the techniques completely for free, right on the computer. Type in the same question after going to www.youtube.com and there will be dozens of videos that explain as well as demonstrate the technique.

With a computer and the internet there really should be no reason why someone cannot learn how to use a new tool and use it well. Between the multitude of articles and videos, everyone should really be an expert at every tool in their shop.



Bathtub As A Water Trough

When bending the sides, sometimes it is hard to find a place to soak them that is large enough, and can hold water tightly. If the shop is also located in the home, there is usually at least one easy solution in every house.

The bathtub is an excellent place to soak wood that needs to be extra wet for bending, and can be found in practically every house. It is large enough, deep enough, and the water can get hot enough to make soaking the sides very easy.

When soaking the sides inside the house, it is important not to leave the side bender on fire in the shop unattended. It is a good idea to drop the pieces in the water, then go out and fire up the bender, and allow it to get to temperature. Once it has heated up and the sides are ready, turn off the heater for a few seconds to run in and get the wood. This way there is less of a chance of an accident which can burn down the shop.

To soak the sides, run the water in the tub with the drain open until it is very hot, then stop the drain and start filling. Even though the sides are very thin, and only an inch of water or less would completely cover them, run a few inches into the tub to help maintain temperature. A larger quantity of water will regulate temperature better, and stay hot longer than a smaller quantity.

Use heavy objects to hold down the pieces of wood, and do not stack them on top of one another while soaking. Clean shampoo and conditioner bottles are great for holding down the pieces, and small gym weights (the non-rusting kind) will work too. After the piece has soaked a

while and is ready for bending, remove the weights and bring it into the shop.

Use A Bending Strap

By far, bending the sides is the most mentally excruciating part of making a guitar, especially for those who have never bent wood before. The skill itself comes with time and experience, like so many other things, and is scary in the beginning. The best thing that can be done to help the process is to use a bending strap at all times.

The bending strap is a thin piece of metal that helps keep the back side of the wood from breaking while being bent. The word to notice there is helps, not prevents. If a piece would just barely break without the strap, having it in place will save it. However, if the piece is really being pushed too hard, nothing can really save it. Using the strap gives the new and even the experienced wood benders a little extra edge, which means more successfully bent pieces.

If bending something that is not as tall as traditional guitar sides, maybe for a thinner bodied acoustic, an old leather belt can be used, as long as it is dye free. The leather holds onto the back side of the smaller pieces just the same as the larger metal bending strap, and it is perfect for sides that are only a couple inches tall. One of these can be found in almost every closet for free, or next to free in a second hand store. A metal bending strap can also be built from instructions earlier in this book.

Be Safe In The Shop

The Lord gave us all ten fingers and he intends us to make it to the end with all of them, which means that being safe in the shop is incredibly important. It is a simple fact that the less fingers someone has, or eyes, or hearing, the poorer of a woodworker they become. Even the best blind woodworker would be better with sight, and so goes for the deaf woodworker and the nine fingered woodworker.

Invest in a nice set of safety glasses, and not the dollar store disposable kind. A good set of glasses will be worn more often, taken better care of, and may actually protect the eyes from something flying off of a tool. The cheap glasses are more for protecting against eye irritants, and will fold up like a cheap lawn chair if something hits them hard. This does nothing for protection, and is a complete waste of money and time wearing them.

Also, purchase a box of foam earplugs, or a solid set of earmuffs that block a large portion of tool noise. If earmuffs are uncomfortable, buy the earplugs, and if earplugs are uncomfortable, buy the earmuffs. The name of the game is to make the safety gear as easy and as comfortable to wear as possible, which will lead to it being worn more often.

Wearing some sort of dust protection is also important, and can be as simple as a dust mask, or as fancy as a complete respirator. The better the dust protection, the longer the lungs will last, and the longer a person can build things from wood. Many wood species contain silicates, which are picked up as the tree drinks in water through the roots. These silicates

are vaporized in the air when the piece is cut or shaped, and they are like tiny pieces of jagged glass that end up in the lungs. While there they build up, and can eventually lead to silicosis, which is an incredibly painful and almost 100% fatal disease. It occurs in occupations where people work with sand containing items like potters, stone cutters, and woodworkers.

Finally, learn to correctly operate and work with every tool in the shop, and use as many pieces of safety equipment as possible along with them. This means use feather boards on table saws, as well as push sticks. On the router, use the fence as well as a push stick, and keep the fingers out of the area of the spinning bit. Fingers are a required part of woodworking, just ask anyone who is missing a few.

Try Something Interesting

When making guitars, many times luthiers fall into the habit of doing things one way, because that is the way they were taught, and that is the way it is done. When making something from wood, there is typically some room for expression, and sometimes trying something interesting can really produce a beautiful instrument.

The guitar in the picture above was inspired by a fellow luthier and friend Gerald Vontietz, of Vontietzenhoffen Basses, who is a classical instrument maker as well as repairer. The purfling is inset about a quarter inch, similar to how the purfling is done in a violin or cello. This is a dramatically different look than the traditional guitar, which calls attention

to the rim. These can be done with or without the trademark bee stingers that are a design staple on violins and other classical instruments.

The actual installation of the purfling this way involved using a dremel tool with the circle cutting jig in a creative way. Using the center pin of the circle cutter as a guide to ride along the sides of the guitar, the carbide spiral cutting bit was traced around the shape of the guitar, cutting out a thin channel for the purfling to reside. This was done in one continuous pass in order to maintain a strict slot diameter, which would need to be absolutely correct not to show any gaps.

The result was an interesting looking guitar, made by trying something unconventional to the guitar making world. This technique came from violin making, which is a lifelong study in itself, and was used in a way that made it a great addition to the guitar. Next time something interesting comes up, try it on a guitar, it just may end up being something amazing.

Make Another Instrument

Interestingly enough, making a different instrument can teach volumes about making guitars, even though something totally different is made. The techniques and the process of making a violin, dulcimer, or bouzouki will expand the woodworking repertoire, and enhance the skills that are already possessed in guitar making.

After making several guitars, the instrument making process will be less of an explosion of new ideas and concepts, and slow down to

more of a trickle. When this happens, the best way to jumpstart the learning process is to start making a different instrument on the side.

This does not mean that making guitars needs to stop, rather it means that the process will slow down a little to allow time to make this other instrument. It will be made in the background, and made much slower than a guitar, because it is for training rather than for playing or selling.

A violin is a much harder to make piece than it looks from the outside, and people have dedicated their lives to learning the delicate art. It is said that violin makers take a decade to learn violin making, and the rest of their lives to learn how to finish them. If a historic and classic instrument is desired, start making a violin in between making guitars. The materials are dirt cheap, and there are only a couple special tools that a guitar maker would not already have. There are many good books on the subject, and one of those with a set of plans should be all that is needed for someone who has made a few guitars.

Violin making teaches the art of carving out an arched top from a solid piece of wood, and hand carving a scroll and peg box. Both of these actions increase the ability to carve the braces on an acoustic guitar top. If a person can carve a violin peg head, they will make very short work of carving the braces.

Bending the sides on a violin is very delicate and trying work, but after bending a few of these, a set of guitar sides will also bend easier. The same goes for bending and gluing the linings, which also increases the skills involved in heat bending binding strips.

The bouzouki is another fantastic instrument for a guitar maker to pick up as a side project, and requires no more tools than any guitar maker would have already. The tuning is different, so the guitar player would have a little getting used in order to make the switch, however it has a very interesting sound.

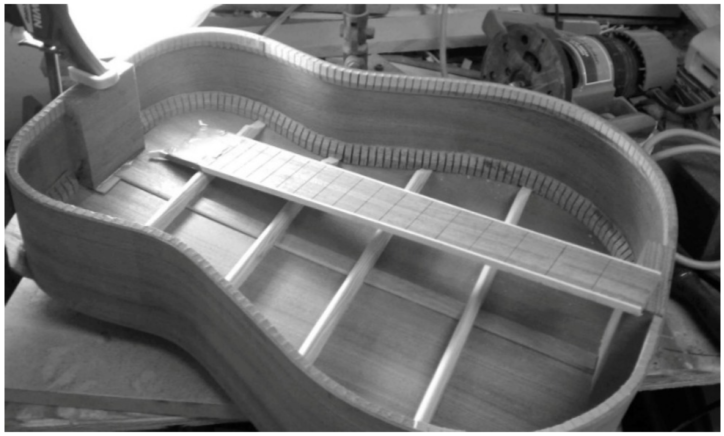
Any instrument that is chosen will take the guitar maker away from the almost programmed habits of guitar making, and force them to think more about what is happening to this new instrument. Even a simple ukulele, which looks like a miniature guitar, will have its own sets of challenges as well as new things to learn. Try making a new instrument to broaden the general woodworking skills as well as the guitar making skills. It does not matter if it takes months to finish, the important part is doing something different, and learning from it.

Make Something Different

Along the same lines as making a different instrument, having a smaller side project in general will also broaden the skill set that a person has, making them a better overall woodworker. Making simple things like rings, pipes, or lathe turning can get the mind off of one aspect of woodworking, and plug them into another.

Any time a tool is used on a piece of wood to make anything, the general skill level of the user also will increase. Over time it will take more and more projects to challenge the woodworker, however it will always serve a good purpose to work on something.

If making a different instrument is totally out of the question, consider making something small that is accomplished in a shorter time. Making wooden rings present their own challenges as well as making tobacco pipes. Even making little wooden cars for children will add some unknown skills to the knowledge base, and in the end it will make a better woodworker and guitar maker.



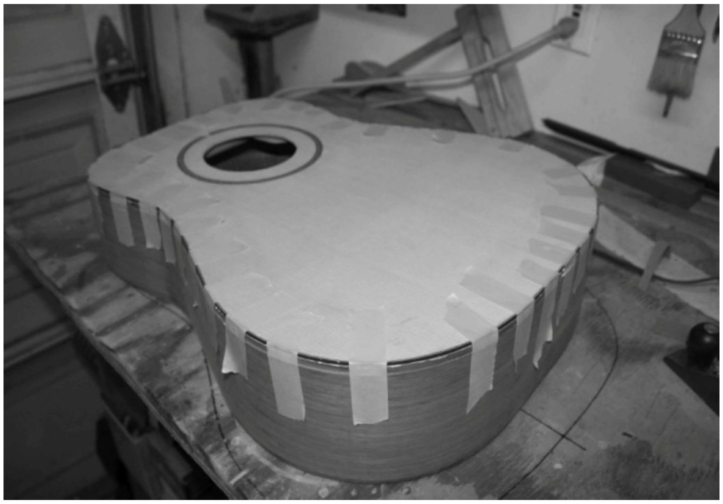
Spanish Cedar Linings

Sometimes very small things can have a large impact on how the guitar is received by a customer or by a member of the family as a gift. A small touch that shows care and thought can really make a difference, and one of these is using an aromatic species of wood for the kerfing.

The job of the kerfing is to give the sides and the plates a little more gluing surface, and they really have little direct control over the sound of the instrument. Many times the strips are made from Mahogany, which can easily be substituted for Spanish Cedar, because they are similar in many ways. The hidden benefit to Spanish Cedar over Mahogany is that when sanded or cut, it will emit a faint cedar smell, much like Aromatic or Tennessee Cedar.

When this species of wood is installed in the guitar, it will emit a very pleasant cedar aroma that will last a long time. When it fades, and it will over time, a light sanding though the soundhole will bring it right back to life.

For some reason, people like to smell the soundhole of the guitar when they pick it up and examine it. It is something about the smell of wood, and the smell of craftsmanship that encourages people to do this. Smell is one of the most underestimated senses, however it is also one of the most powerful in humans. When playing a handmade guitar, it is nice to have the smell experience also be as pleasant as the playing experience.



Use An Interesting Species

Guitars can be made from far more wood species than Mahogany, Rosewood, and Spruce, and a handmade guitar should have some character. If using exotic wood for the back and sides is not something that can be done yet in the shop, consider even changing something easier like the bridge, fretboard, pick guard, or binding strips.

Most guitars are made with Mahogany and Rosewood, which is a great choice, and will make an excellent guitar. An excellent guitar that looks like every other guitar ever made. Making a custom acoustic guitar allows far more freedom in wood choice than buying one, so take advantage of this new found freedom and express some creativity in wood choice.

The guitar above was made with Padauk, which is an interesting species of wood, because it is bright orange when freshly cut. This coloring gradually darkens over time, until the wood is a very deep red with black grain streaking through it. The colors run next to each other like many different shades of red ribbon, and the definition between the colors is well pronounced.

When working with Padauk, the pieces can be a little on the brittle side, especially when they are made very thin for bending. If the sides are left a little thicker than normal, they can be soaked for a couple hours and bent with only a little more effort than any other set of sides.

The use of an interesting species of wood does not have to mean going all the way and making a back and sides out if it. The exotic species used can be as simple as a Bocote bridge, a Cocobolo headstock veneer, or

a Wenge end flash. Start out small, and work up to making backs and sides from Zebra Wood, Bubinga, Sapele, and Bocote.

Acetone Before Gluing Rosewood

Certain species of wood are very oily, and these include most of the members of the Rosewood family. If a piece of wood has a mild sheen to it after a fine sanding, or has a waxy look to it, then it is a good bet that it is on the more oily side.

The issue that sometimes comes up when gluing oily woods is that the glue can fail to adhere well, causing a potential separation in the future. A good practice to get in the habit of is to leech the area of the wood that will be glued and allow it to dry before the glue is applied.

When joining the back together for a book match, dip a cotton swap in some acetone and run it along the edges. This will pull out the residual oil in the wood that is near the surface, and create a better area to glue. This needs to be done within the same hour or so that the pieces will be glued, because the oils will work their way back.

Allow the acetone several minutes to fully evaporate, leaving dry wood behind. Once the evaporation has completed, glue the pieces together like normal.

Especially when gluing something exceptionally oily like Cocobolo, it is very important to use a solvent like acetone to leech out the

oils. Wood glue has a tough time grabbing onto the wood when there are oils present, and the joint will likely fail over time.

The acetone to be used needs to be pure acetone from the hardware store, and not the kind that is used for removing fingernail polish. This type has several other chemicals in the mixture including acetone, and their effects are unknown on wood.

Double Wide Planer

Power planers are sold based on their size, and the wider planers will sell for far more than the more narrow planers. 12" is the basic starting place, and they can go up to 24" and wider depending on the application. The trouble with a guitar back is that the width is 16", which will be wider than any basic planer, unless a little trick is used.

When planing the sides down to thickness, do not glue them together before they are sent through the plane. Plane them separately and send both pieces through the machine each time, then adjust the level to remove more wood on the next pass. Once they are the correct thickness, then glue the pieces together.

Always Use Quarter Sawn Wood

A simple act that can help the guitar making process to move along more smoothly is to try and always use quarter sawn wood. Unless a piece of wood is being sold flat sawn in a guitar making catalog or online, use and trust only pieces that are quarter sawn. There are several reasons for this choice, the most important of which is that it is stronger and more stable.

Quarter sawn wood has the advantage of being stronger than flat sawn wood, as well as less prone to breaking along the grain. When being bent, quarter sawn wood has the fibers lined up in the correct direction where they bend easily without cracking, which would ruin the piece.

When making a neck, a piece of straight grained and well quartered wood will not bend as easily under the string tension, and will also tend not to twist over time. Being able to make a rock solid neck is a very important part of guitar making. When starting out the process, using the best cut of wood is important. A piece of wood with the grain running in any other direction except parallel to the strings, can twist due to certain areas being more rigid than others. The weaker areas give before the stronger ones, causing a twist.

Backs and sides will plane easier, look nicer, and bend easier when using quarter sawn pieces of wood. The backs especially tend to get the most beauty from pieces that are quarter sawn, and the book matched image created is usually better looking.

When selecting guitar wood, try as much as possible not to use anything that is not quarter sawn, unless a good experience has been had with a certain piece already. The wood will be more stable, and stronger, which will lead to better made instruments.

Keep The First One Simple

It is a well known fact among any hand crafted profession that it is far more satisfying to execute a simple design really well than to stumble through a very complex design and make a terrible mess of it. Especially when making the first instrument, which will have a large bearing on whether more are made, shoot for a design that is not far beyond the current skill level. It is a virtue to try new and challenging aspects of guitar making in order to develop new skills, however this should be done in stages rather than all at once. Add a new element or two on each build rather than trying to create a legacy piece on the first try. This will result in better executed designs, and an overall better experience in guitar making.

The guitar pictured on the previous page is the very first acoustic guitar that I ever made, and it is a very simple design. The plans came from an old Gibson that belonged to my grandfather, and by plans I really mean the tracings and the measurements. The guitar was a very old solid Mahogany instrument, and it had a very cool sound to it. In order to be sure that this guitar making experiment would yield at least a semi-working

instrument when it was finished, a few features of the guitar were removed to make it easier to build.

First of all, there is no binding what so ever on this guitar, but there were a couple chances to practice a bit of inlay in safe places. The back has a single Maple stripe down the middle, and the end has a beveled piece of end flash. Instead of using binding to hide the joints, they were rounded over with a router, and sanded until they were very even. The radius on the edges is a very prominent feature of the guitar, and eliminates several hours of binding work.

The entire body of the instrument is made from Mahogany, which is easy to work with and very soft on the tools. This is typically the lightest species that will be used on a guitar for the back and sides, and one of the easiest to learn on. Because of all of these properties, Mahogany was an easy choice for the bulk of the woodworking.

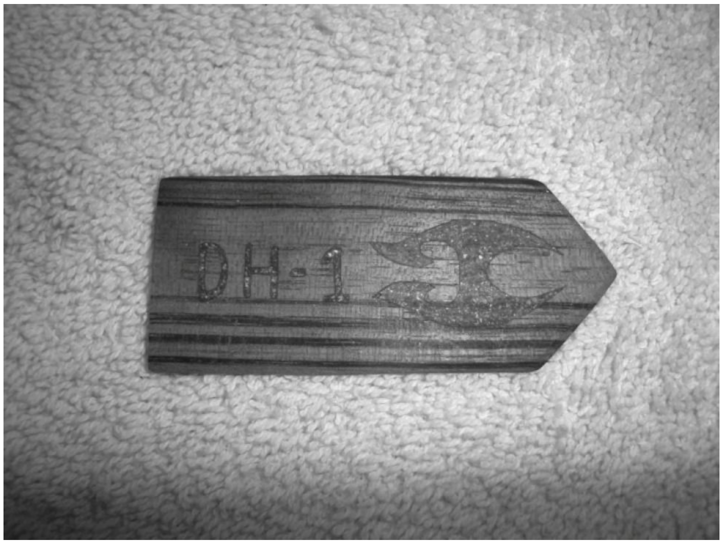
The fretboard is Goncalo Alves, which was a little diversion from the normal, and the fret dots are installed closer to one side of the board. This allowed for the opportunity to work with an exotic species on a safe place on the guitar, and learn some new skills without taking too large a risk. The fret dots are a little unconventional, however the process of installing them was exactly the same. The only thing that was a little different was where the holes were drilled.

The fretboard has a completely flat fretboard, which is similar to a classical guitar, and is only slightly more difficult to play on than a fretboard with a radius sanded onto it. The headstock is a basic symmetrical design, and the hardware is very basic as well. There is not even a rosette around the sound hole.

The point of the guitar was to make something that worked, and something that would not ruin my taste for guitar making. This simple design came out well for a first instrument, and I am sure that it looks much better than had I attempted too much right out of the gate. It is better to make a basic design really well than to ruin a complex one, which this guitar is a perfect example of. The design may not win any fashion awards, but the guitar plays nicely, looks great to me because it was my first, and is an instrument I was proud to show people at the time it was made.

There will be time to make plenty of guitars as a life filled with woodworking and guitar making goes on. There is no need to try and cram everything into one of them. Instead, try adding a new layer of complexity

to each successive build, and offer a new challenge in each new guitar. These challenges will be easier to overcome because they are coming in stages instead of all at once, and the resulting instruments will all keep on getting progressively better.



Use Inlace For A Simple Inlay

For an early guitar or an instrument where a nice looking and easy to apply inlay is desired, InLace is a ready mixed epoxy and stone product that can be poured into an inlay cavity and sanded flush when cured. It comes in several different looks from turquoise to blues and darker colors, and is ready to use right out of the box with just a little mixing.

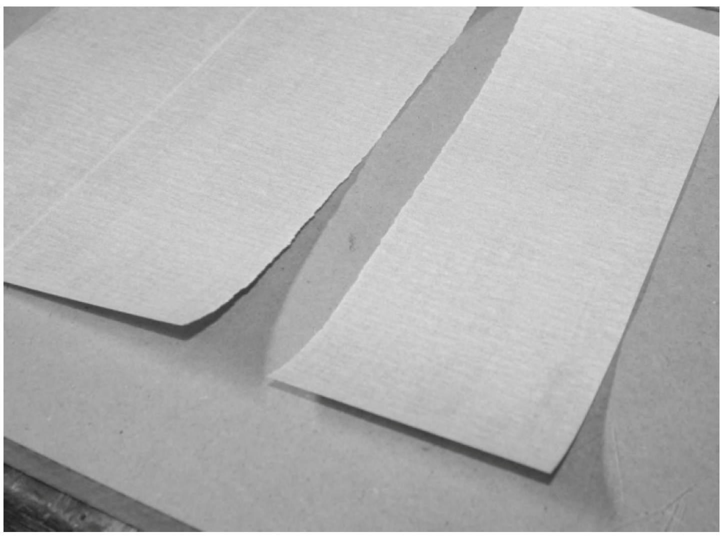
The desire to shoot for the moon on an early guitar can sometimes overshadow the abilities of the woodworker. This results in poor looking and haphazardly built guitars. One way to add a nice touch to an early instrument is to use InLace to create an easier inlay. The look will still be excellent, however the installation process will be made far easier.

The truss rod cover above was for an early instrument, and bears a symbol that the customer liked as well as the model number, which are his initials and the number 1. The cavities were made using the Dremel tool and a carbide cutting bit, and then the InLace was poured into them. After a few hours to cure and harden well, the excess was sanded flush to the wood, and the result was a nice looking and easy to make inlay. This again was a

way to add a nice embellishment without going overboard and possibly making a mess of things.

Essentially, if a cavity can be made, InLace can be used to fill it for an interesting and very good looking effect. It is worth trying out on at least one guitar, and can be effective in several places around the instrument.

InLace can be found online and in several fine woodworking stores. It only requires a little mixing with the supplied hardener and it works exactly like two part epoxy, because that is essentially what the basis of the product is.



Cutting Down Sandpaper Sheets

When using a palm sander that takes quarter sheets, it is far more economic to cut down larger sheets into quarter sheets than it is to use pre-cut pieces. For some reason a small pack of quarter sheets costs almost as much as a pack of full size sheets with the same number of pieces in the package. That means getting four times the sheets for the same price.

The savings can be taken even further if a larger pack of sandpaper sheets is purchased. These are normally away from the power sanders and located in the painting area of the hardware store. If a bulk pack is purchased, which will all end up being used anyway since sandpaper does not expire, the savings are even more over buying the pre-cut sheets.

A quarter sheet of sandpaper is literally 1/4 of the sheet, so fold a large sheet in half one way and tear it into two pieces. Then, fold it the

other way and tear it again. One of these resulting four sheets will fit on the bottom of the sander perfectly, and will cost far less than buying the pre-cut sheets.

Any time some money can be saved on something that will be used all the time like sandpaper, it is a win for the guitar shop. Looking around the hardware store, many times there are other ways to accomplish the same task for less money.

Wiping Glue Residue Immediately

When gluing anything to anything else, it is beneficial to remove all the glue residue while the glue is wet, instead of waiting until it has dried. Especially for glue joints where the two pieces are already fully shaped, such as gluing a bridge to the soundboard, wiping the glue is very important.

The process of gluing up several pieces to make a neck blank will require lots of glue and clamping pressure. This will cause much of the glue to run out of the joint and get all over the blank. In this case, removing the glue will be helpful in the long run, but not as crucial because the blank will still be machined before using it. During the shaping, planing, and jointing process, the neck blank will have all the glue removed anyway, meaning it does not need as much attention as other times.

When gluing the bridge to the soundboard, or gluing the neck to the body, this is a time when removing as much glue as possible while it is wet becomes incredibly important. As glue dries to the surface, it seeps into the pores of the surrounding wood, filling them deeply in some cases. If this

is allowed to dry, it will be in there permanently unless much of the top layer of wood is sanded through.

Finally, one of the best reasons to remove the glue with a wet rag before it dries is to reduce the chances of damaging the guitar. A chisel will be needed to carve off the dried glue, meaning there is a chance that the chisel can dig in and gouge the guitar if it slips accidentally. This will cause far more of a repair than having to remove glue, which is why wiping it off with a wet rag is the easiest method.

Use an old wash cloth for this process, as long as it does not have any really dark staining, and is white in color. Wash rags have small twists of thread all over them, making them more absorbent than a thin piece of cotton cloth. Wet the rag with cold water, and wring it out thoroughly before bringing it to the workbench. The rag itself needs to be wet enough to dilute the glue, but not so wet that water runs everywhere when it is used. Any water that gets on the surface will need to be wiped up with the rag, preventing any puddles from being left behind.

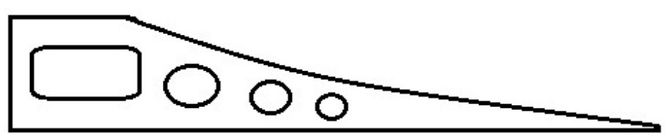
A puddle of dilute glue will dry as a thin layer of glue, causing blotchiness that will need to be sanded out later. This is better than leaving it, but still can be eliminated completely by wiping better with the rag. It will not hurt the wood or the joint at all for the wiping to last for several minutes, repeatedly wetting and wiping the surface until all the glue residue is gone.

Vacuum The Soundhole

Nobody likes the small pieces of wood shavings that become trapped inside the soundhole of the guitar while being made. It seems that there are always a few of them rattling around inside the soundbox no matter what, and they are miserable to remove. Also, wood shavings laying around the box can vibrate along with the guitar itself, causing funny sounds that lessen the tone and playability of the guitar in general.

The conventional method of removing these small shavings has always been to shake the instrument over and over trying to eject the pieces from the soundhole. Though this will work, it takes a ton of time and can cause the guitar to be dropped accidentally.

A far better way to remove the shavings is to use the hose from the shop vac to suck them all out, leaving the body completely free of shavings. First, the body needs to be shook a little, to get all the shavings to come up towards the upper bout, and pile up in one of the shoulders. The hose of the vacuum is then carefully stuck inside the body, sucking out all the shavings. If the hose is allowed to go deeper into the body of the guitar, it will create so much turbulence that it will get any remaining shavings floating around in the air. This will cause them to eventually be caught by the suction of the hose, and removed.



Drilling Holes To Lighten Braces

The whole point of a soundboard is to be as light as possible while still being strong enough to hold up under the tension from the strings. It has long been a balancing act between making a guitar that will be strong enough to last for a hundred years and making one that is delicate enough to respond to the slightest tough. Making some holes in the braces can help with this struggle by making the braces lighter but not very much weaker.

The traditional way to make a brace lighter has always been to remove material from the top or the sides, changing the shape and lightening the weight of the piece. This unfortunately reduces the structural

abilities of the braces, especially when the height is lowered by removing wood. Thinking a little differently, wood can be removed from the centers of the braces by drilling, which does not affect the structure very much, and lightens the braces significantly.

In order to make this type of construction work, the rough dimensions of the final bracing scheme will need to be known. This will prevent any drill locations from being carved through, reducing their strength. Since it is very hard to drill these holes with the braces already on the soundboard, they will need to be marked on the brace blanks and drilled before they are glued.

Mark out the rough profile of the braces, and inside those marks plan for where the holes will be drilled. A good rule is not to take out any more than a third of the total amount of wood in the brace, and be sure to stay at least 1/8" from any edge. The idea is to remove wood from a strong part of the brace, where it really is not needed. Removing wood from the thinner areas and getting too close to the edges will weaken the braces significantly, making them worse off than before they were drilled.

If the braces are already on the guitar, an aircraft drill bit, which is a bit with a very long shaft can be used to drill out several smaller holes into the structure. Keep them spaced well, and drill carefully as to prevent blowing out the other side and breaking off too much wood.

CHAPTER EIGHT

FINISHING TECHNIQUES

There is something magical that happens when the first coat of finish is applied to a guitar after several long weeks or months of building. The wood transforms from a piece of rough and dull colored lumber that lacked depth and character into something that is unexplainable to someone who has never seen it firsthand. It is almost magical how the wood can go from the unfinished state to something that is a thousand times more beautiful with just a simple wipe of a rag. I have finished dozens of guitars, and the moment the first coat of finish is applied is still as amazing of a moment as it was the very first time.

Of all the techniques in guitar making, finishing is the one subject that brings up the most concern. There are people who really get into the fine details of finishing, and there are many of them to learn if that is desired. There are also people who can care less and just want the guitar to look good. There is a third class as well who think that finishing is some ancient art that is part witchcraft and part alchemy, making it a lifelong study that is impossible to fully understand. Interestingly enough, there is truth to all three examples.

Finishing can be made as hard or as easy as a person wants to make it. There are volumes of reading about the complexities of finishing and how to properly apply finishes, and each of them will teach something new. There are also tried and true ways of finishing a piece of wood that when followed step by step, yield a good looking guitar. Though the details may not be known about why the process works as it does, the results make the question irrelevant. There is something to be said about knowing a few methods of applying a finish that work really well, and using that as a base to build off of.

Having used Tru-Oil for years as my primary guitar finish, I never knew that it was a polymerized oil, or that is was a film finish that

could be built up upon itself layer by layer. I also never knew that it was made by cooking natural oils to get them to dry faster than oil alone. None of these things mattered at the time however, because the finish made a great looking guitar without needing spray equipment. As time went on, the desire to know more about why it worked lead to learning more about the type of finish itself, and now I have a far better understanding of it. Finishing only needs to become more complex when the knowledge is needed, until then it can remain easy and understandable.

There is also the third group that was mentioned earlier, who are the witchcraft and alchemy crowd. Though I do not support the overall idea that old finishes were some mysterious magic bullet that made classical instruments sound better, there is some truth to their research. Finishing needs to be seen through the lens of how it effects the instrument, and the old masters had to know that a thick and gummy finish would hurt the sound of the instrument more than enhance it. Once the time comes to learn some of these more meditative aspects of finishing, it will be a good supplement to the knowledge and skill discovered by knowing the basics. Just do not think that modern finishes are not as good as older historical finishes, because in many ways they are far superior.

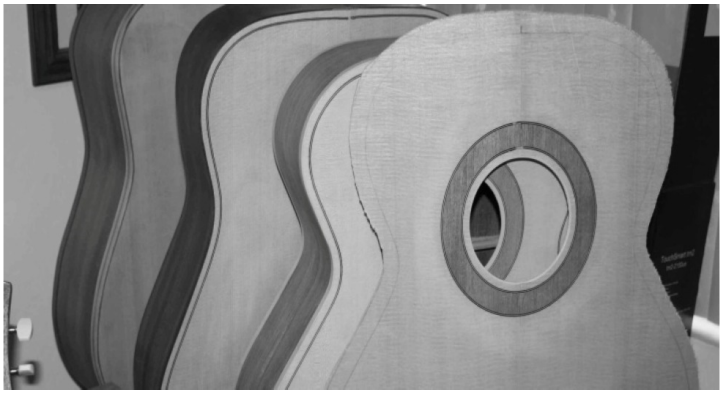
When learning how to finish wood, the most important thing that can be done is just to keep on working at it. The only way to get better at something is to practice, and that goes for finishing as well. A great way to hone these skills is to use some scrap wood and start applying finishes to them. They may end up being the prettiest pieces of junk wood that anyone has ever seen, but that would be a really good thing. Practice always makes perfect.

In This Section We Will Cover:

Why finish wood at all, and what makes a good finish for an acoustic guitar. See here.

How to prepare the instrument for finishing, and why this makes a difference. See here.

Raising the grain, and how some finishes make wood rougher after being applied. See here.



Filling the grain as an optional step, and what to expect from the process. See here.

Making a test board to carefully and safely test a finish before applying it to the guitar. See here.

The advantages of hand finishing an instrument instead of spraying. See here.

Layering a complex finish, and why this is sometimes an advantage. See here.

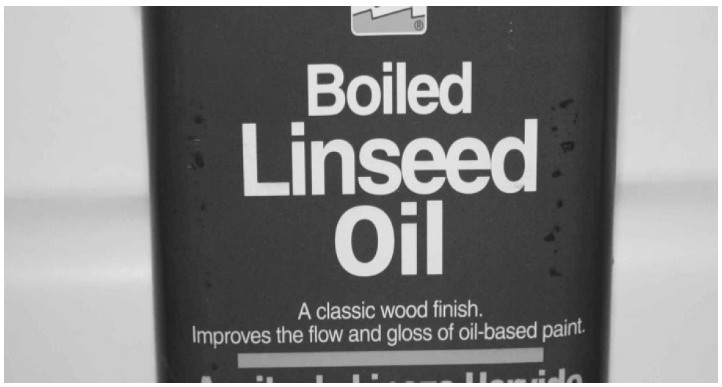
How to hang the guitar for finishing to keep both hands free while working. See here.

How Tru-Oil can make an expert wood finisher out of anyone. See here.

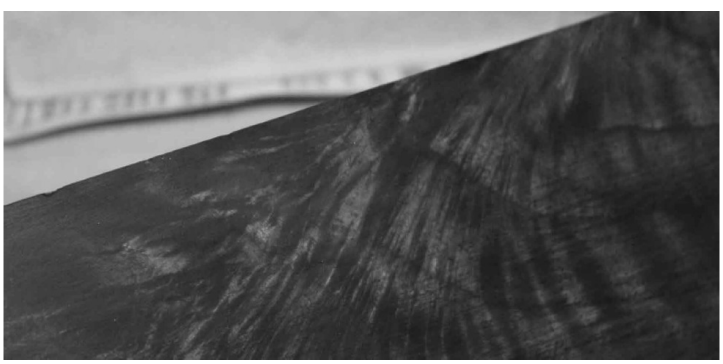
Using Danish Oil to add warmth and glow in an easy to apply oil finish. See here.

How wiping varnishes make super smooth and glossy top coats for guitars. See here.

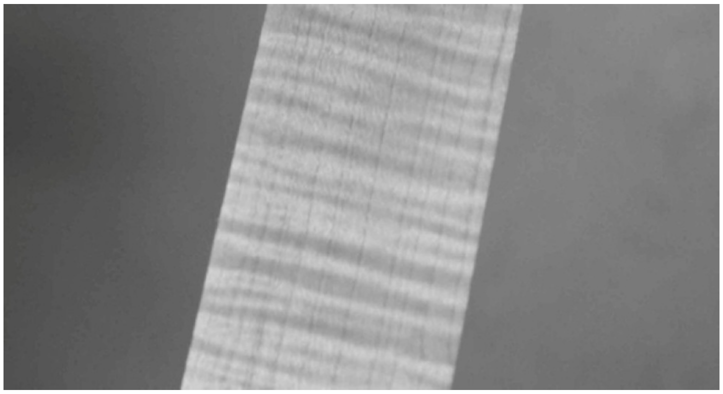
How to store, prepare, and use shellac as a traditional instrument finish. See here.



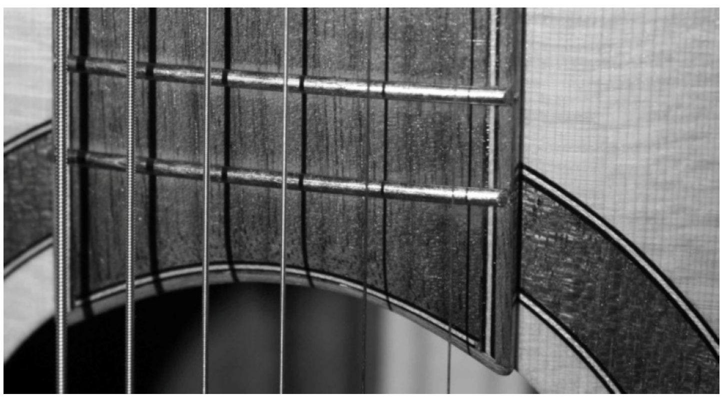
Using boiled linseed oil as both a base coat as well as a final finish with great results. See here.



Using dyes to contrast stain figured walnut, making the grain come to life. See here.



How to do a simple grain pop on figured Maple or Mahogany. See here.



Finishing tips and tricks that will take much of the frustration out of finishing. See here.

Project Notes:

When it comes to finishing, there really is no reason to be scared or intimidated. It is no different than any other aspect of woodworking, and is a skill that takes time to hone. Dedicate some time to practicing the craft, and soon it will be just like any other task.

Part of the reason people get nervous about finishing is that there are simply so many different products to choose from. This is similar to many aspects of life, and can be seen anywhere things are sold. There is really no need for a choice of over a hundred different types of

toothpaste, but they are sitting on the shelves right now at the supermarket.

Choice sometimes leads to confusion, which is why this finishing section deals exclusively with four very easy to apply and time tested finishes. These will make an expert finisher out of anyone, and will have a professional look without the hassle and frustration of a very complex finish.

Layering and complex finishes are explained, however a very good looking finish can be had with any of the four main finishes alone.

WHY WE FINISH WOOD

The finish on a piece of wood serves several important purposes. There is protection provided by a good finish, as well as resistance to wetness. A well applied finish also keeps the moisture content of the wood from changing too rapidly, effecting the structure of the guitar. Finishes also bring out the beauty of the wood that cannot be seen until the finish is applied. The finish is a very important step to finalizing the guitar for a long life of great playing, and should be treated with the same care as any other major part of guitar construction.

A primary function of a guitar finish is to provide a protective layer over the instrument that will shield it from harm. Small scratches, dings, dents, and other minor things happen to guitars over time, and the purpose of the finish is to help reduce the effect of these.

There is a balance to be struck however between the protectiveness of a finish and the ability of the guitar to vibrate. The more finish is applied to a guitar, the better the protection will be. However, if the finish is too thick, it will reduce the ability of the guitar to vibrate, meaning less sound production in the end. Too thin of a finish on the other hand will

let the guitar vibrate well, but will not protect the wood from moisture from the hands, or small scratches from being played.

The level of protection needed for a guitar is also determined by the future owners of that instrument. A player who is careless with a guitar would do better with a thicker finish, and a player who treats the guitar like a newborn baby can survive with the bare minimum. Each guitar in either case will be well protected from harm, because of the type of finish applied to it.

The second function of a finish is to help the wood maintain equilibrium through changes in humidity. Wood is a hydroscopic material, meaning it will absorb and release water from the air in response to it being either humid or dry. When wood absorbs water it expands in size, and when it releases water it contracts. This movement can be tough on joints and glued areas, and can cause them to pop apart if enough stress is created.

Finishing helps slow down this process, so dramatic changes in the air are only minor changes in the wood. It does this by sealing off the wood from the outside air, only letting it pass through the finish slowly.

Finally, the obvious reason for finishing wood is that it makes the wood look more beautiful than without a finish. Oil based finishes especially have the ability to give depth to a piece of wood, and enhance the contrast between the colors. This explosion of color and depth is referred to as popping the grain, and is possible on almost any piece of wood.

When a finish is applied to a guitar for the first time, a magical transformation occurs, and a fine instrument is born. It is the finish that brings out the hidden beauty in wood, and shows off what the wood really looks like.

PREPARING THE INSTRUMENT

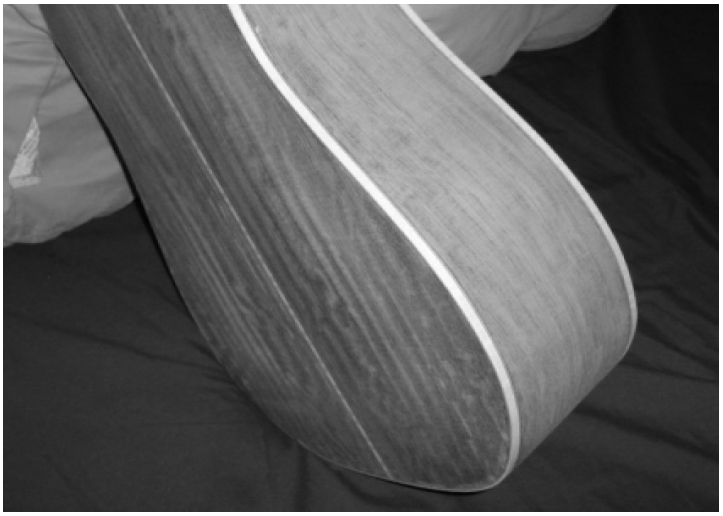
Before an instrument can be finished, the surface must be ready. The sanding and scraping must be completed, leaving a smooth surface behind, and any glue needs to be removed. Gaps anywhere need to be filled or inlaid over, and any surface dirt needs to also be cleaned off. Finishing over any of these imperfections will show through the finish worse than it looked before, and an extra bit of time spent preparing the instrument for finishing is worth it.

The surface of the guitar must be free from sanding marks as well as any scraper marks before finishing, and it also needs to be smooth enough to take a finish. If a cabinet scraper is being used, this will itself leave a smooth enough surface to finish directly. However, if using sandpaper the instrument needs to be brought up to 220 grit, and be free from scratches from the sandpaper. The way to remove scratches is to do the last bit of sanding with the grain, which will line the scratches up in the same direction as the grain, effectively hiding them.

Start the rough shaping with a cabinet scraper or 100 grit sandpaper. Work the tough spots, removing any dimples or blemishes by working a wide area and not just digging into one place. Doing so will create a shallow dent that can be seen when the guitar is held up at an angle.

Once the majority of the wood has been removed, switch to 150 grit and remove all the scratches made by the 100 grit. After that, switch to 220 grit paper, and finish making the surface smooth and blemish free. Only sand until the surface is smooth, and the scratches are gone. Once a surface is sanded to 220 grit, it can be sanded with 220 for days and it will never get any smoother.

The cabinet scraper will do all of this without having to sand over the same area repeatedly, and there is a whole section dedicated to it in chapter three.



After the sanding is completed, blow off or wipe off the sanding dust, and check the guitar for gaps or holes that need to be filled. Sometimes in the process of putting on the binding, a couple small gaps form. These can be filled with wood dough, or sawdust and glue as explained in chapter seven. Address any of these areas now, because finish will not build up in large gaps, nor will it ever dry properly if dripped in there in an attempt to fill the space.

The last step in surface preparation is to do a thorough wipe down of the entire instrument with a barely damp rag or tack cloth. A white wash rag or dish cloth makes an excellent sawdust remover, and it is easy to look and see if it is removing anything from the surface. Oils from the fingers, grease, grime, and dirt in general are enemies to the finish adhering well. All of these must be removed prior to starting the finishing process.

With the sanding completed to 220 grit, any gaps filled, and all the wood dust and oil removed from the surface of the instrument, it is ready to take a finish. There are a few more optional steps on the following pages that will help make sure the finish goes on well, and the process goes smoothly.

RAISING THE GRAIN

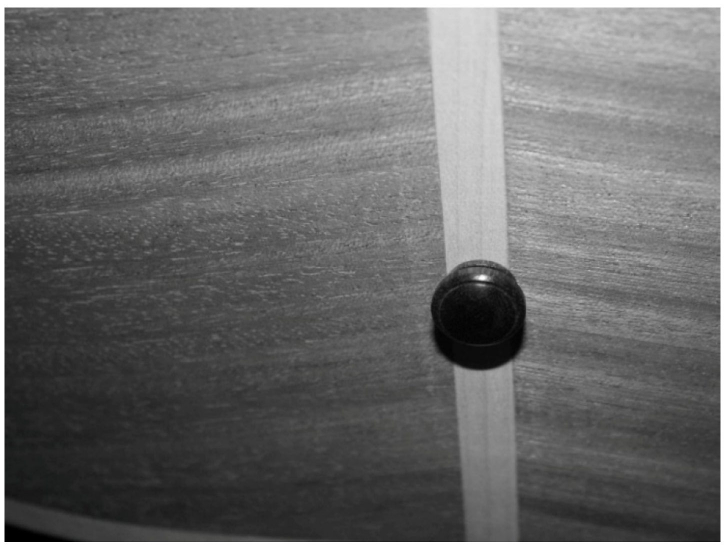
Raising the grain on a piece of wood or a guitar is simply the act of wetting the fibers in order to make them swell, allowing them to dry, then sanding them off. This process is also called de-whiskering the wood, and the two terms can be used interchangeably when referring to the same process.

De-whiskering the wood is done before applying a finish, as most finishes will themselves raise the grain at least a little. This makes a finer surface under the finish, and thus a finer surface is possible on top of it as well.

To raise the grain on an instrument, first have all the sanding that will be done on it completed, and any gaps or holes filled and sanded level. This is literally the last step before wiping the guitar down and applying finish coats. If there is something that needs a large amount of sanding after the grain is raised, it will need to be done again afterwards, so be sure to save this step for dead last.

Begin with a wet rag, not dripping wet but more than damp, and start rubbing it on the surface of the guitar, getting everything wet. Start on the top, then move to the sides so there is no transfer of dark colored sawdust to the nice light colored top. Once the entire guitar has been dampened, hang the guitar to dry for about an hour.

What will happen on a very small level, is the ends of wood fibers that have been ground up and shredded during sanding will absorb the bulk of the water, swell up above the surface of the wood, and then dry there. When the fingers are rubbed along the guitar after it dries, it will feel like beard stubble, and the difference between the two surfaces will be very dramatic.



Once the guitar has dried, the fibers need to be sanded off to the level of the surface. This is to be done with a fine grit of sandpaper, one grit level higher than the last used on the guitar. If that is not available, a used piece of the last grit will work fine as well. In the case of most instruments, they are sanded to 220 grit, which means use a piece of used 220 grit or a new piece of 320 grit.

The idea here is to break off and remove the small hairs that are now sticking out through the surface, but not to go any further than that. Very lightly sand, a few degrees off of completely parallel with the grain because we do not want to drive the fibers back into the small crevices they came from. The goal is for the sandpaper to remove them, but by the same

token going completely against the grain would cause more problems for the surface than it would solve.

Work lightly all over the guitar to remove all the hairy fibers, not working for too long in any one area. When the guitar is completely sanded, use a clean cloth to remove all the sanding dust. The surface should now be as smooth as glass, and free from any of the stubble feeling it had earlier.

If the process went well, and there is no more stubble feeling, the instrument is ready to move on to finishing. If there are still some scratchy areas, sand them again lightly and wipe the dust off.

Project Notes:

The grain can be raised more than once if desired, however it will have a diminishing effect with each raise. In fact, the second time should not produce much if any additional fibers, because the remaining fibers after sanding are not as destroyed as the previous ones were. Still, a second wipe with the damp cloth can drive out a few more fibers that can then be sanded flush, and the instrument finished with super smooth results.

FILLING THE GRAIN

The wood used on the back and sides of a guitar is typically an open grained wood. The term open grained means that the pores which helped transport nutrients while the tree was alive are visible to the naked eye. Wood species like Padauk, Mahogany, and Bubinga all have large open pores that can easily be seen. Other species like Maple also have pores, however they are so small that they cannot be seen, and do not need filling.

The choice to fill the grain or not is simply aesthetic. Filled grain will give the appearance of total flatness in the wood. Since the pores are small openings, finish will not fill them in to the same level as the rest of the wood, leaving small dimples that can easily be seen. Filling the grain eliminates these dimples, and leaves a completely flat surface behind.

When the pores are left open, the look of the wood is a little more natural, though it cannot be shined up to a mirror finish because it is not completely level. Whichever way the guitar will be finished, both the filled and the un-filled looks have their own beauty and style.

There are a couple ways to fill the pores and level out the finish. The easiest of which is to use a dedicated product that is made for filling in the small holes quickly. When purchasing one of these products, make sure

it is compatible with the finish being used, which means use an oil base filler for oil finishes and a water base filler for water base finishes.

The finish may even have a filler product that is designed and marketed for use with the exact product the guitar is being finished with, which in this case is the picture above. Tru-Oil has a specific filler they manufacture that is meant to be used before the Tru-Oil finish coats. Most gun stocks are made of Walnut, which is an open pored wood, so the filler is used after any staining, and then coated with Tru-Oil afterwards.

Since the finishes discussed in this chapter are oil based (most hand applied finishes are this way) oil based fillers are going to be the best choice for a filling product. Several companies make them, so bring the finish that is going to be used into a fine woodworking store, and select an oil based grain filler that will be compatible with it. Check with the staff to make sure they will work together, but just about any oil base filler will be fine.

The directions on each brand and type of filler will vary a little, however there are some things that will remain constant. The directions should be followed on the can or bottle, but the following will serve for a basic run through.

Most fillers are to be applied heavily on the surface and spread out using a brush, making sure to coat the surface much more than when applying a finish coat. The objective is to get as much filler into the pores

as possible, so wiping with a cloth is not the best choice. Hand wiping will remove as much grain filler as it deposits, dragging it out of the pores about as fast as it goes in. Use a brush and coat the surface well, leaving the grain filler to dry a little thick.

Some grain fillers will ask that once the product has dried for a little while, maybe 20-30 minutes) that the bulk of the product be wiped off the surface with a rag. This must be done perpendicular to the grain, so the chance of removing filler from the pores is reduced. Work perpendicular to the grain, mopping up most of the half dried filler. Leave the rest to dry for several hours or overnight, then sand it all level and smooth before finishing. The goal should be to have no filler residue on the surface, and only flat wood with filled pores remaining.

If the filler does not recommend wiping away the excess, shoot for a thicker than normal coat, but do not leave the surface too thick. The products that are not wiped are meant to be left to dry overnight until the filler hardens, and then the excess can be sanded off. Obviously the more left on the surface, the more sanding will have to be done, so get enough in place with the brush but do not make any mounds.

The beauty of the grain filler products is that they can be applied over and over again. Once the first coat is sanded back, if there are any open pores they can be coated and sanded back again. If two or three coats are required to finally get a flush and level surface, it will not look any different than if one coat did the job. The only difference will be a little time, and finishing takes time anyway.

Another way to get a smooth filled grain look is to use multiple coats of finish that build up with each new layer. Once several layers are built up, the surface can be sanded level and a flat finish will be the result. In this case the finish itself actually does the filling, though in a much slower fashion.

When applying finish, the reason little dimples appear is the liquid finishing product seeps into the pores and dries a little below the surface. The next coat builds up that dimple a little bit, and the following coats all do the same. After enough coats are applied, the level of the dimple is actually built up so it is level or slightly higher than the surface of the wood. Once this happens, the finish can be sanded back to level, leaving a grain filled surface.

This sanding must be done after the finish has had at least a few days to harden and solidify so it can handle being sanded through so much. It is also a good idea to use special sandpaper that can be used wet, and will not load up. A weak mixture of soapy water can be the lubricant for the sandpaper, but make sure to check it from time to time to see that it is not corning, which can mar the finish quickly. Corning is when sawdust or finish dust gets stuck to the sandpaper, clogging it. These little clumps then drag on the surface and scratch it. Unless the sandpaper is checked often, corning can cause real finishing problems.

Work on one section of the guitar at a time, using a flat backer for the sandpaper to keep it even and help remove the finish a little better.

Once an area looks good, wipe it off with a towel and check to see how level it is. Once it is nice and flat, go on to the next area. This process should not take too long in one section because only the top fraction of the finish is being removed.

Take care not to cut completely through the finish while using soapy water, because the soap may cause trouble on the bare wood, and may end up leaving a stain.

Once the whole guitar has been sanded level, wipe off all the sanding residue as well as any soapy residue remaining. Clean the guitar thoroughly by wiping it a couple times with a damp rag, making sure all the residue is gone. The weak soapy water solution should not leave much at all behind, unless it was made with too much soap. A drop of soap in a large container of water is all that is needed.

Hold the guitar up to an angled light and check the surface all over. It should appear completely flat, and there should not be any dimples or open pores. If this is not the case, coat with a few more layers of finish and sand again until it is perfect.

Once the guitar has been leveled well, the final coats of finish can be applied in the same manner as the first coats were. These are going to be the top most layers of finish, and they should be applied very thinly to minimize any more sanding that may have to be done.

Apply several thin and even layers, taking care to wipe up any excess finish or thick areas. Follow the finishing schedule for the product being used, and allow the instrument to cure fully before handling.

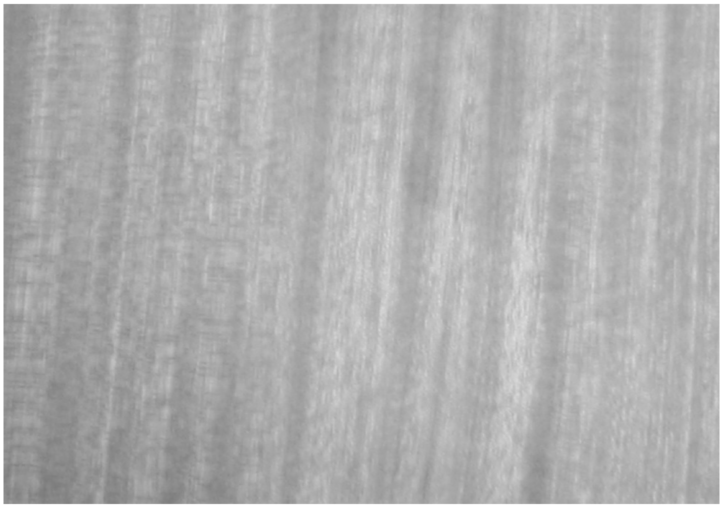
Project Notes:

The pore filled look is great for super glossy finishes that are destined to be buffed out to a very high gloss. When the surface is totally flat, like after filling the grain, the layer can be buffed up to a mirror finish. This cannot be achieved with open pores, because the dimples on the surface distort the light hitting it, making it hard to get a really good reflection.

MAKING A TEST BOARD

When working with complex finishing techniques, or simply wanting to know what a finish will look like before committing to it, a test board can be made. A test board is a piece of wood that is the same species as the wood being used on the guitar, and it is used to try out different finishes. It does not have to be a large piece, but it cannot be really small either. It will show how the final finish will look, and if it is not the desired effect, will save a guitar from being finished badly.

Lay out and organize all the finishing products that will be used on the guitar, and therefore also used on the test board. This may be as simple as one bottle of finish (maybe Tru-Oil) or several items like a dye stain, grain filler paste, shellac, and a wiping varnish.

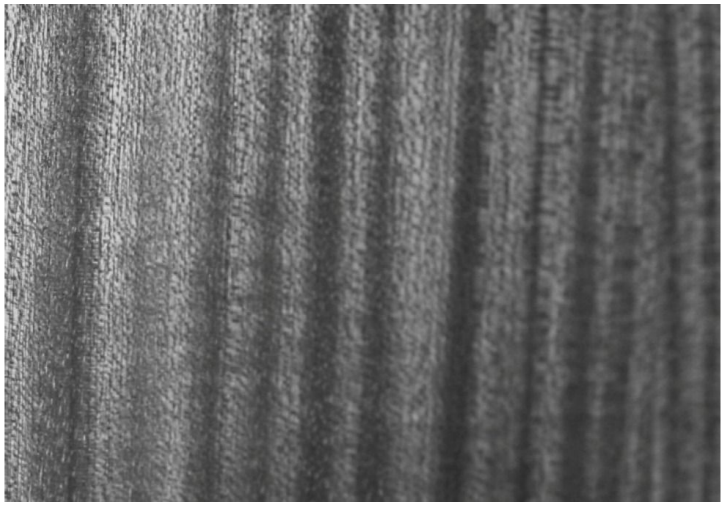


Start with a scrap of wood of the same species and approximate figure as the one being used on the guitar. This piece should be at least a few inches by a few inches. The pieces that were cut off of the back plate when it was cut to shape will work well too, though they will be a little odd shaped. The point is to have enough wood to test out the finish and be able to see if the look is good enough to finish the entire instrument.

If several steps are involved in the finishing process being explored, make sure that they are all done on the test piece. Small things like filling the grain, using a sanding sealer, or layering multiple coats will change the way a finish looks in the end. If a test board is to do its job, then it must be finished in the same exact way as the guitar would be.

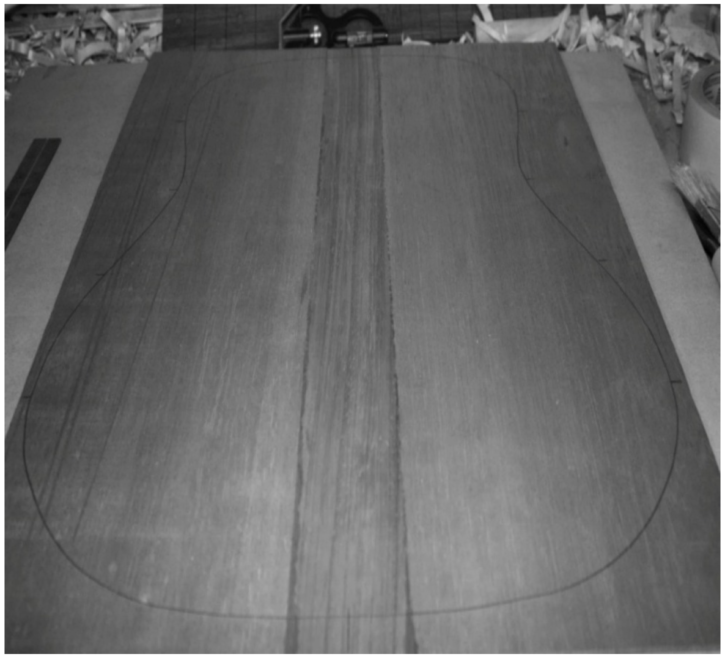
Start by sanding the test piece down to the same grit as the final guitar, or by using a cabinet scraper to smooth it out. If the grain is to be raised on the instrument, raise it here as well. Though staining is rare on a guitar, if any staining is to be done, do that first, then fill the grain if desired. Apply the top coats in whatever order they will be applied in the final look, and apply the same predicted number of coats.

Though it sounds very quick in the above paragraph, this process could take days or weeks to complete. It is a good idea to complete this process as the guitar is being built, this way there is no rush to complete the steps or skip the process entirely. If it is left until the end, it will be very difficult to have the patience to finish the test board before proceeding to the actual guitar.



Once the board has been through the same exact process as would be used on the final guitar finish, allow it to cure for a week or better and then examine it. Look for things that are desirable on a finish like popping the grain, having a close to the wood look, and having a natural feel. Also, check that all the ingredients in the finish scheme worked well together, meaning everything dried well.

A tell tale sign that certain elements of a combination finish did not work well together is when the finish never fully dries. When finishing products are layered over one another, the types of products must agree with each other to some extent. This can be helped out by allowing the first layer of finish to completely cure before applying the second one, and so on. If everything dried well, and the finish looks good, it can be applied to the guitar without worry.



A good time to do a test board, even if using a finish that has been applied many times, is when a different species of wood is being built with. A finish that adheres to one piece of wood will adhere to most, though it may look different depending on the coloring of the wood.

A finish that imparts an amber effect on a piece of Mahogany, might look a little orange if applied on Padauk. Adding yellow/orange (amber) to a piece of wood with a large amount of that color in it already may not be the best look, or it may look amazing. The beauty of a test board is that it will show exactly how the final look will be, without taking a guess and possibly ruining a guitar.

The guitar above had a test board made for it because it combined a piece of Spanish Cedar for the majority of the back, with a very large Padauk stripe down the middle. Since the Padauk was so big, a test board was made to be sure that the finish being used would look equally good on both species.

Any time there is a large contrast like in the above picture, it is a good idea to test out the finish first. Binding strips are the exception because they are so thin that that they normally do not affect the final look as much as larger pieces. However, when in doubt, make a test piece out of the same species of wood, maybe gluing a small strip down the middle to

represent a binding strip. Once the finish is applied, it can be viewed just like the final guitar would be.

A	B	C	D	E	F	G

A= Bare Wood
B= Shellac
C= Danish Oil (Watco)
D= Tru-Oil
E= Boiled Linseed Oil
F= Wiping Varnish
G= Tung Oil

A test board can also be used to test out multiple finishes on a single board, in order to determine which one will look the best on the final guitar. A single board of the same species is needed for this, and it should be a few inches wide and a few feet long for the best results.

Sand the board to the same grit as will be on the guitar when it is finished, and raise the grain if necessary. Once the surface preparations is completed, the board will need to be marked.

Depending on how many finishes are going to be tested, divide the length of the board into that many boxes plus one, using a permanent marker to separate them. Only a around six inches of length is needed in these boxes, as long as the board is a couple to a few inches wide. It is a matter of personal taste how much wood needs to be finished to be able to tell if it will look good on the guitar. However, a few inches by a few inches will work for most people.

Leave the first box completely blank, which will be used to compare the finishes to the original wood coloring without having to turn over the piece and look at the back. Staying in the lines, apply finish to each of the boxes, keeping a list of what kind of finish went where. Allow all of them to dry together overnight, and apply a second coat. If a little more

depth is desired, wait until they are all dry and apply a third coat. Usually two to three coats is enough to see what the final finish will look like for each product.

Examine the board and make a selection based on which finish looks the best on that type of wood. If it can be narrowed down to two products, flip over the board and apply one to each half of it for a better look at a larger finished piece. At this point, it should be easy to decide which look will be the best for the instrument.

ADVANTAGES OF HAND FINISHING

There are several advantages to finishing an instrument by hand instead of by using spray equipment. The equipment is inexpensive, the finish can be controlled very easily by hand, and it can be done virtually anywhere in the shop or house. Hand applying finishes is perfect for the amateur as well as the professional who wants a traditional hand rubbed glow to their instruments.

Spray equipment can be an expensive investment for the amateur or hobby guitar maker, and using it can be even more expensive. A good spray gun and air system will require a dedicated space to operate it, which many guitar makers do not have the money or space for. Spraying requires its own set of skills much like hand applying a finish, though it also requires a larger space and much more equipment.

For the non-professional guitar maker who does not need to pump out many guitars efficiently, applying finishes by hand is a perfectly good method, and will give results that are just as good as by spraying. The old masters did not have spray equipment, and their finishes were beautiful just the same.

The hand applied finish is actually much easier to control than people think. A finish, when applied very thin with a cloth, is far easier to make flat and even than when using a spray gun. The advantage of the hand finish is that it is very easy to go back and add more finish or rub a little off with the cloth. The spray gun only adds finish, which means that unless the solution is more finish, it will be hard to solve.

The cloth is the secret to applying the hand finish, and it can be used to both effectively deposit product as well as soak it back up into the cloth. This way the level and amount of finish being applied can be carefully monitored and instantly addressed.

The hand applied finish also has the advantage of being able to be applied in virtually any place in the home or the shop, without the need for any special room. Hand finishing only requires a room with an open door or window, and a place to hang the guitar while working on it. There is no need for large air fans to pull away fumes, or special filters to trap particles.

Hand finishing also gives a traditional look that many people are searching for in their instruments today. The mass production look of an inch thick lacquer job has a cheap feeling and even cheaper look to it. A hand applied finish tends to have a warm glow due to the oils involved,

which amber the tone of the wood slightly. This amber effect gives the look of warmth, age, and tradition that cannot be found on a mass production lacquer instrument.

Project Notes:

Hand finishing does require a little bit of practice to become good at, but not as much as people would think. Try using some Tru-Oil or Danish Oil on a practice board, applying it with a small piece of cotton rag or cloth.

Dab some oil on the rag, and begin wiping it all over the surface of a small board, maybe 6" x 6" in size. Only use a small dab of oil, and work it as far as it can go before adding more to the cloth if needed. After the first coating is done and the whole surface covered, wipe over it all with a clean part of the rag, removing any excess. When this board looks good, it is time to move on to a guitar.

LAYERING A COMPLEX FINISH

Though many of the finishing products described in the book are meant to be used on their own or in conjunction with one more product, there are some benefits to layering a complex finish on a guitar. There are some things that one finish cannot do alone, which means that a second or third product is required. It is important to make sure a layered finish is compatible with all the products being used, and also to make sure there is something to gain by adding a certain product to the mix.

Different finishing products have their own qualities that they impart on the wood being treated, and they need to be thoroughly understood before they are combined together.

Shellac for example is a good looking and natural finish, and it has a fantastic amber quality to it that adds a warm vintage glow to anything it is applied to. That being said, it is not as tough at resisting water as other finishes, and moisture tends to show is as white cloudy spots or dull areas if left on the surface too long. Guitars are held near the body, and

can get sweat on them for a long period of time. This could cause some clouding of a shellac only finish.

Oil finishes are beautiful by nature because they penetrate into the surface and bring out the natural look of the wood. This beauty cannot be seen until the surface is wetted with oil, bringing out a depth and richness that cannot be described until seen. The down side to oils are they offer next to zero protection from scratches and dings that will happen over time as a guitar is played.

A varnish is a clear coating that offers great protection from handling, scratches, and wear and tear, however it does not do very much for the look of the wood that it is applied over. It seals everything very well, but does not offer much of the color or grain enhancing qualities that the previously mentioned finishes do.

The obvious next step is to layer a few of these finishes to take advantage of their individual qualities, making a superior finish than any of them could do by themselves. As long as the finishes are given ample time to cure before the next layer is applied, they will all adhere to each other well, and last a very long time.

First, use an oil like Boiled Linseed Oil, Danish Oil, or Tru-Oil to liven up the grain of the wood and give it depth and character. The oil does this the best, so it will need to be applied first, in order for it to be able to penetrate into the wood. Allow the oil to completely cure, which can take two weeks.

Next, layer a coat of de-waxed shellac in a two pound cut. Allow this to dry and add more coats until a gentle amber effect is imparted on the piece. Once the coloring is right, allow it to cure for several days to a week.

Finally, apply a layer of wiping varnish over the shellac and the oil, which will add a protective layer over the top, trapping everything inside. The protective qualities of the varnish are utilized to keep the two lower layers safe from scratches, moisture, and any other harm.

In this manner the strengths of each finish are exemplified in the final look, and the weaknesses of each product are minimized. Together they make a finer and longer lasting finish than they would have separately, and add a complexity that a single finish could not ever hope to achieve.

There are other products that can also be added into the mix, each adding another layer of complexity and depth to the final look. There are stains that can be used under the oil which will enhance the look of the piece as well as add color.

A basic dye stain in a simple color can be laid down as the base layer for the finish layers, enhancing the color and the depth. A dark stain over dark wood deepens the look, and makes the wood look more interesting. Also, a slight red tint in a dye stain over mahogany or another medium colored species, can add a subtle but easily detectable color hue that will show through in the final instrument.

There are dyes that are made to stain Mahogany, giving it a red hue or a brown hue, as well as stains meant for Maples, imparting an amber or slightly brown hue. These are great first layers if staining the instrument is not considered sacrilege as a personal opinion.

If a stain is going to be used, it needs to be the very first layer in the finishing schedule, because it will need direct contact with the wood in order to work correctly. Lay down a coat of dye stain cut with denatured alcohol and allow it to dry overnight before going on to the oil application.

If staining the wood sounds like too much of a hassle, coloring can be added in the shellac layer that will tone the entire instrument evenly. Any time a weak color is added to a finish coat and applied evenly over the surface it is called toning. This allows several coats to be applied, which will gradually build up the color to full strength.

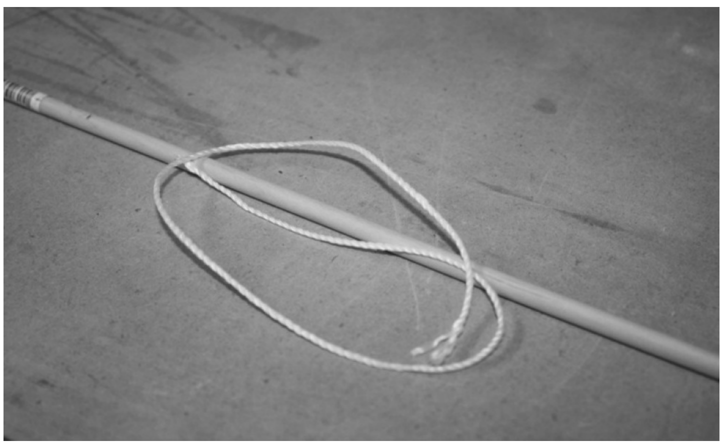
Use aniline dyes that are designed to be cut with denatured alcohol, and add some directly to the jar of already mixed shellac. Swirl the contents well until they have mixed thoroughly and the color evenly dispersed. Do not go full strength on the dye application at this point, because it is meant to be a subtle effect that adds complexity. A bright red shellac coat is not subtle at all. However, Reds, yellows, and oranges work best for toning in small amounts.

Apply a few coats of shellac over the oil once it has completely cured. Apply coats every couple hours until the coloring looks as desired. Once the color is right allow the finish to cure a week, then go to the varnish.

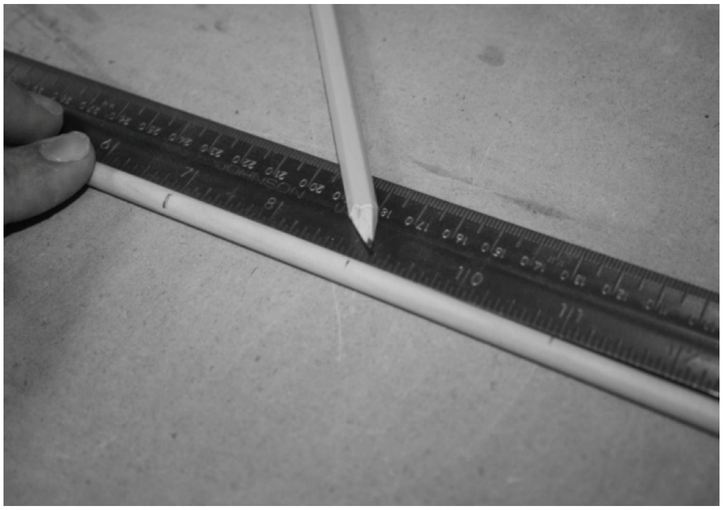
It is a good idea to scuff the surface with 0000 steel wool after each layer of finish has cured completely, and before applying the next layer. This will help to keep the layers smooth, and eliminate any difficulty in leveling the final finish later on.

END PIN GUITAR HANGER

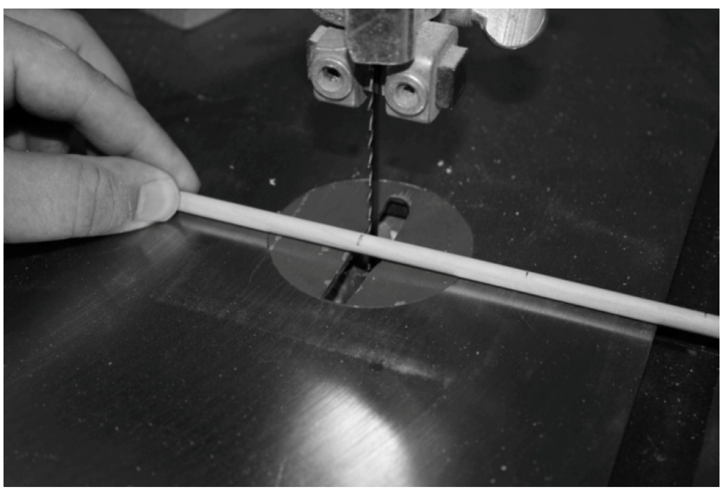
Holding the guitar while the finish coats are being applied can be difficult, and laying the guitar down with a fresh coat of finish on it will completely ruin the surface. An easy way to hold the guitar in place while it is being finished is to make an end pin hanger from a dowel and a piece of string. This will hold the guitar suspended in the air while the finish is applied, and remove simply after the process is complete.



All that is required for this hanger is a long piece of strong string, and a dowel rod that is made of a good strong wood. The string needs to be strong and quality made so that it does not break and drop an expensive instrument. Get the best that can be used while still being very thin, since it will need to fit through a very small drill hole. The dowel should be anywhere from 3/8" to 1/2" and does not need to fit through the end pin hole.



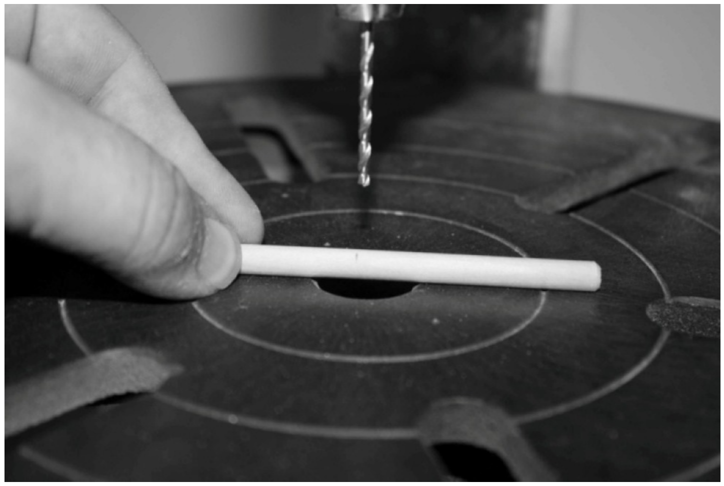
On the dowel rod, measure and mark out a piece that is 4" long, and carefully mark the center of the piece as well. This will be held flush against the end pin hole of the acoustic guitar, and used to suspend it while it is being finished.



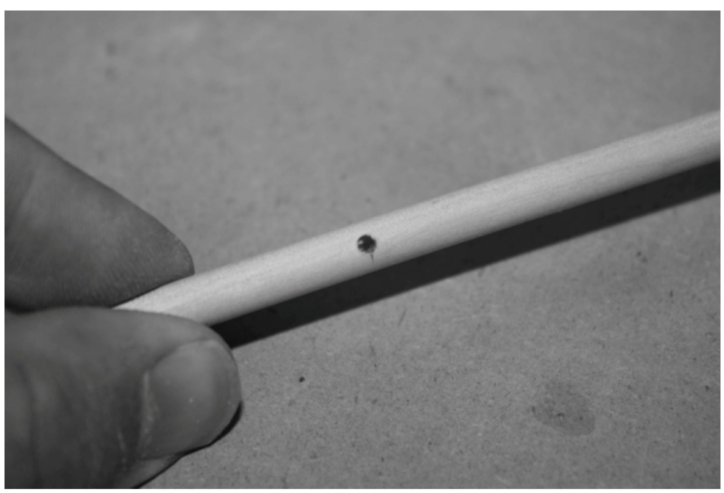
Cut the piece to length on the band saw, or with any other saw of choice. Do not worry about the ends splitting a little bit because they will be cleaned up later.

Chamfer the ends of the dowel on the belt sander carefully, to remove any rough spots.

Once the chamfering is completed, the end of the dowel rod should look like the picture above, nicely smoothed out. The purpose behind chamfering the ends is to make them smoother and to remove the roughness from the cut. If a belt sander is not available, use a piece of sandpaper and a wooden block to go over the ends. This is mainly for aesthetics, though anything worth making is worth making it nicely.



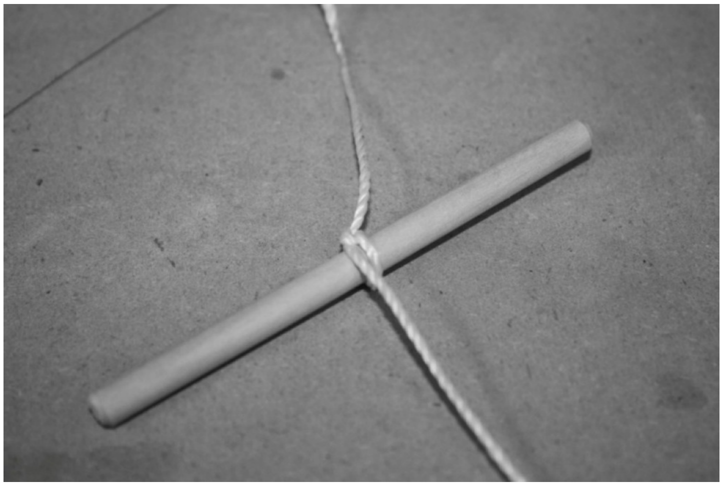
Drill a small hole through the center of the dowel that is no bigger than half the diameter, which will not significantly weaken the piece. Use a drill bit that will allow the string to pass through the hole, but not much more room than that. Before drilling anything through the actual dowel rod, test out a couple drill holes on a piece of thin scrap to be sure that the string can pass through easily enough.



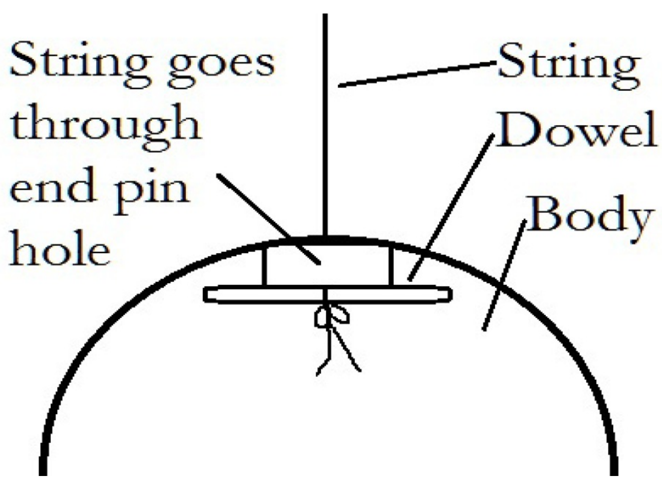
The picture above shows the hole drilled into the dowel, and that it is clearly not any larger than half the diameter. In this case it looks like it is closer to a third of the diameter, which means that the dowel will retain its strength while the guitar is hanging.

If the hole were too large, there would be a risk of the center area of the dowel being weakened, and possibly resulting in the failure of

the dowel. A break in the dowel would send the guitar plummeting towards the floor, neck first, which would not be a great ending. Make the hole as small as possible, and the reward will be not having to worry about the guitar falling in the middle of the night, or during a coat.



Fish the long piece of string through the end pin hole of the guitar, and out of the soundhole. Tie the end to the center of the dowel tightly, and with several knots. A little extra tying will not hurt anything, and is a little extra peace of mind. Pull the string back towards the end pin, taking the rod with it, and it should seat itself against the end block of the guitar.



Inside of the guitar, the hanger should line itself up as seen in the diagram above, and is ready to be hung from the ceiling and finished. This is a very sturdy and capable method of holding the guitar, and it frees up both hands to apply finish.

Project Notes:

Essentially, a large washer, large nut, or any other object that is small enough to fit through the soundhole, but too large to fit through the end pin hole, can be tied to a piece of string and used to suspend the guitar. The dowel is meant to be more of a permanent tool than a large washer tied to a string, which will be lost, thrown away, or forgotten someplace in the shop. If a 30 second solution to hanging the guitar is desired, tie a fender washer tightly to the string, and hang the guitar for finishing.

TRU-OIL FINISH

One of the easiest finishes to apply that gives one of the best looks when completed, is Tru-Oil Gun Stock Finish by Birchwood Casey. This is an oil finish that has been cooked in order to make the finish dry faster, and it acts more like a varnish than an oil. It can be applied with a rag, or even a couple fingers according to the manufacturer. The advantage to this kind of oil finish is that it protects better than a regular oil does.

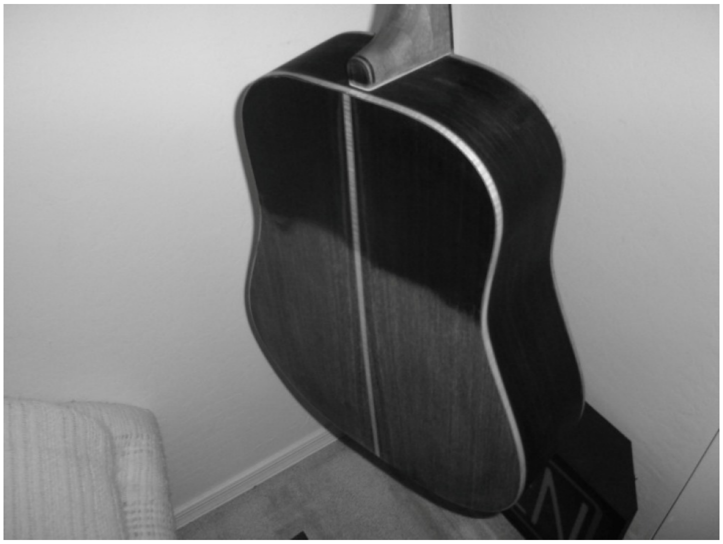
Oils penetrate into wood and leave nothing on the surface for protection. Tru-Oil does penetrate a little to bring out the grain of the wood, but it also hardens on the surface, meaning it protects better than regular oil alone. In this way successive coats can be laid over each other, and layers can be built up over time. The advantage to building up a layer of finish is that it can then be buffed out to a high gloss, or rubbed with steel wool to a matte finish. A solid layer of finish is also a better barrier against scratches and dings than a finish that only penetrates.

Tru-Oil can be found online from many guitar supply houses, but it can also be found in sporting good stores, because it was originally formulated to be used as a gun stock finish. There is only one state that I know of that currently bans Tru-Oil and that would be The People's Republic of California. Apparently small woodworking shops are the cause of the huge smog cloud over Los Angeles.

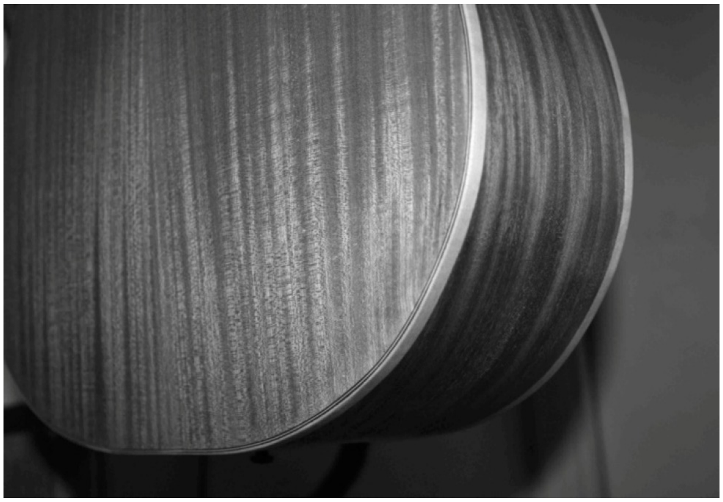
If Tru-Oil cannot be found in your state, a similar look can be obtained by looking further into this chapter and doing a two part finish. Step one will be an oil to bring out the grain and highlight the look of the wood. Step two will be to coat the guitar in a varnish to provide some protection from scratches on the surface. The beauty and simplicity of Tru-Oil for a first time finish, is that it does all these things with one product, and in one repeatable step.

The beauty that Tru-Oil brings out in a piece of wood is something extraordinary to see. In the picture above, the top half of the neck was only given a very light coat of the oil, and the bottom half left natural. The bottom looks the same as the top as far as figure and grain, however it cannot be seen as easily as when the finish is applied.

The sparkle and the flash of the ribbon figured Sapele was completely hidden until the finish let it shine through and become visible.



Rosewood also does really well with Tru-Oil as a finish, and goes from a dull looking charcoal and brown color to a very deep and rich brown and black color. The depth of color cannot be shown in any picture, and has to be seen in real life to truly be appreciated.



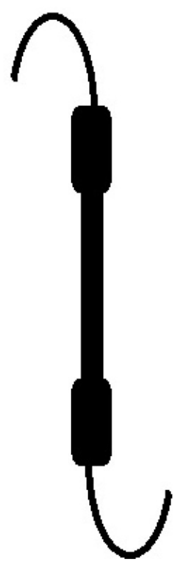
The ribbons on this guitar virtually explode after the first coat of Tru-Oil, however it does not do anything that would obscure the brightness and contrast of the binding strips. This because there is only a very small amber tint to the finish, and it takes many coats in order to show up as a very subtle amber glow.

To prepare the surface for finishing, sand the entire guitar to 220 grit, and finish by sanding in the same direction as the wood grain in order to hide the scratches from view. Do a very close inspection of the surface for any sanding marks or tool marks, and remove them when found. Small swirls from the palm sander especially are revealed once the finish coats go on, and they will be very visible. Spend a few extra minutes sanding the body, and the finish will look far better than rushing into finishing.

Once all the imperfections are dealt with, use a rag or a tack cloth to remove any sanding dust from the entire surface. Shake out the rag, and repeat this process to get every speck of dust off the surface. At this point it is best to handle the guitar by holding it with the rag instead of by hand, because the oils and sweat from the hands can get into the wood, preventing the finish from adhering well.

Tru-Oil does not contain any water, nor does it swell the fibers, so there is no reason to raise the grain and de-whisker the wood prior to finishing.

Finishing with a wipe on product can be done on a table, however it becomes much easier if it can be done with the guitar hanging from something. An easy way to hang the guitar is through one of the peg head holes, and there are several places around the shop or the house that make excellent places to hang the instrument while finishing.



A very easy and effective hanger can be made with an old bungee cord. The hook on one end can be bent if needed to get into the peg head hole, and the other can be left as-is to hang the guitar from. The track above a closet that the door slides on is one place the guitar can be hung from, as well as the track of an overhead garage door. With the guitar

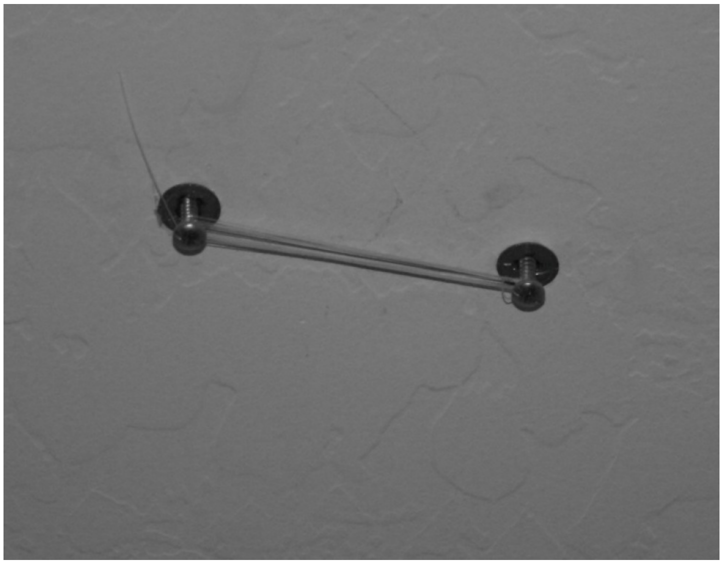
suspended, it no longer has to be finished on one side, then flipped for finishing on the other later. It can all be finished at the same time, making the coats look more uniform as well as cutting the time it takes to finish the guitar in half.

Take the bungee cord and fold over the stretchy part until it is around six inches long. Wrap this folded over section in duct tape or electrical tape, effectively taking all the spring out of the bungee cord, and making it firm. The bent hook can go through the top most hole in the peg head, and the other hook can suspend the guitar while it is being worked on.

Lastly, there needs to be a place where the guitar will be taken to dry between coats, and to cure for the couple weeks that it takes for the finish to really harden. The best place for this is a little used room in the house, away from dust and floating particles that can stick to the still wet

finish. The less that people go into this room the better, however after the first 24 hours of drying, the guitar finish will be tough enough that it can be touched without ruining it.

Select a room in the house, preferably with a ceiling fan, where the guitar can be kept out of the way while drying. With a wet rag, clean off the blades of the ceiling fan if this has not been done in a while, to prevent dust from being spread. When the guitar is placed in this room between coats or for the final cure, switch on the ceiling fan to help the finish dry.



In order to hang the guitar from the ceiling, a small fixture is needed for the bungee cord to hang from. This is a simple solution using two drywall anchors (the corkscrew type) and some fishing line between them.

Sink two anchors into the ceiling a couple feet from any walls, and only insert the screws half way. Tie a small length of fishing line between the two screws by wrapping it around the heads several times and tying a good knot. The hook on the bungee can be slipped over the fishing line, and the guitar safely hung to dry.

If the pores are going to be filled, Birchwood Casey sells a companion product for filling the grain before using Tru-Oil. It is a simple process of applying several coats and sanding them all back until they are level. I prefer the natural look and texture of the pores, so I do not use the filler. However, it is described in detail in this chapter if more of a flat look is desired.

To apply Tru-Oil, a scrap of white undershirt or cotton cloth is needed. Cut out a piece that is a few inches square, and fold it in half twice. This will make a nice pad to rub the finish on with. Always work in a well ventilated area, and wear a dust mask as well as safety glasses.

Hold the pad tightly over the open mouth of the bottle, and turn it upside down for a second to deposit some oil on the pad. Starting on the top of the instrument, begin applying the oil. It does not matter in what direction the oil is applied, or how long the strokes are, simply work in one area until the oil is well spread out and the coating is very thin. Apply more oil to the rag the same way as before, and work the next area, applying a very thin coating of oil eventually over the entire instrument.

The point to remember is to create a very thin layer of finish, to where it almost feels like it is being wiped off completely. Tru-Oil works the best when the coats are applied exceptionally thin, and will look terrible if the finish is dumped on the surface in an effort to build it up faster.

There is no real order that needs to be strictly followed, however the top should always be the first to get a coating with a fresh rag. The top is typically a lighter wood, meaning anything that the rag might have picked up off the darker back and sides, could be transferred to the top if they were

done first instead. Always use a fresh rag, and always start with the top when finishing the instrument.

Once a coat is applied, hang the guitar in the drying location carefully, and let the coat dry for 2-6 hours, depending on the temperature and the humidity. Places with higher humidity and cooler temperatures will need longer for the coat to dry than places with low humidity and higher temperatures. A good rule is not to rush the finishing process, because it is still going to take a couple weeks to fully cure anyway, so rushing to save a day really will not help all that much. Once the finish is dry to the touch, it can be coated again, and this process repeated until the coating is thick enough to buff.

Using steel wool between coats is optional, because the coats will be going on so thin that it will be easy to break through the finish. Also, very thin coats tend to be very smooth coats, so they require less steel wool. The piece will have enough of a layer to steel wool lightly after three coats have been applied, and a good compromise is to steel wool after every third coat.

Apply several more coats until the thickness of the finish increases, and the amber effect is more pronounced. This is largely a matter of personal choice, because some people will like the subtle glow of an amber look, and others may not. Any number of coats between three and six will make a good finish, though as many as 12 can be applied if a strong amber look is desired.

Finishing Schedule:

Step 1 Sand and prepare the surface for finish, removing all imperfections and completely removing all sanding dust.

Step 2 Apply a very thin coat of Tru-Oil finish using a clean white cotton rag. Hang the guitar to dry for 6 hours.

Step 3 Repeat step 2 until three coats have been applied to the guitar, and leave it to dry overnight.

Step 4 Lightly scuff the finish with 0000 steel wool, making sure not to go too aggressively. Only knock down areas that feel rough with the wool, and wipe off the residue with a rag.

Step 5 Repeat step 2 three to five more times until the coloring and thickness of the finish looks pleasing to the eye. This is a personal choice, and anywhere between three and six coats will make a great looking finish. More finish will mean the subtle amber effect will come through more. Allow the finish to dry overnight.

Step 6 Lightly scuff the guitar with steel wool, this time covering the entire guitar. Wipe off the residue with a rag afterwards.

Step 7 For a glossy look, apply an incredibly thin final coat of oil, and hang the guitar to cure for two weeks. If a matte finish is desired, nothing needs to be done after step 6, since the steel wool will leave a uniform matte look. Hang the guitar for two weeks, and let the finish fully cure before adding hardware to the guitar and stringing it up.

After the finish has cured, there are a couple items to address that will make the finish work better on the guitar. First of all, the back of the neck will need to have most of the finish removed.

As with most finishes, the sweat that builds up on the hands while playing causes the surface to become sticky, making it hard to move around from fret to fret. Use some 0000 steel wool, and remove most of the finish from the back of the neck where the hands will touch. When the coat looks very thin, and a little lighter in color than the rest of the instrument, it is a good time to stop with the steel wool, and wipe off the residue.

Check the back of the neck, and if it feels nice and smooth, it is done. This will take a little getting used to in order to get right every time, however the consequences for failure are not very high at all. If too much finish is removed and the wood is exposed, simply coat it again with Tru-Oil and let it dry a couple days. If the surface still gets really sticky when playing the guitar, steel wool it again, and it will smooth out the finish a little more.

Blend the area that was smoothed out with the steel wool into the heel of the neck and the headstock area. This will only require a little attention with the 0000 steel wool to make it look like a natural transition from area to area. It should not look like there is a sudden huge difference in the finish, so take the time to blend the neck into the heel and headstock to conceal this difference.

If the neck is to have a glossy look to match the rest of the guitar, use a piece of white cotton rag and quickly rub back and forth on the back of the neck. In a couple minutes this will restore some of the luster, though it will never be a full gloss because there is not enough finish on the neck.

Project Notes:

Finishing does not need to be as scary as it is made out to be. A trusted product, applied well, and taken time with, will make a great looking finish. Tru-Oil especially makes anyone look like an expert finisher, because it is such a forgiving and easy to work with product.

Take time with each step, and make sure that all parts of the outside of the guitar are coated with Tru-Oil before hanging it to dry. Keep a dust free place in the shop or the house where the guitar can dry without worrying about dust embedding itself in the finish.

When the finish is curing, run the ceiling fan if possible for the entire time, to keep the air circulating and the finish curing as efficiently as possible. Make sure to open the window or the door to that room from time to time to keep the gasses from building up.

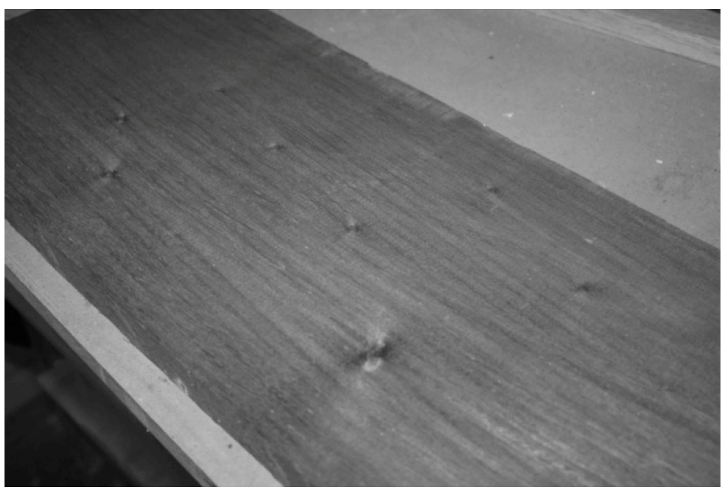
Once the finish has cured, it will be a hard exterior coating over the wood, and will offer some protection from scratches and dings. It will not however be as effective as the super thick coats of lacquer found on cheaper guitars. These instruments are meant to be handled poorly, so the extra finish helps keep them from being damaged.

Handle this guitar well, and the finish will last a lifetime. If Tru-Oil is good enough for a hundred year old gun, then it is good enough for a fine handmade guitar.

DANISH OIL

Another fantastic finish for acoustic guitars is Danish Oil. Though there are several products sold under this name, the Watco brand is a mix of an oil and a varnish that brings out the beauty of the wood and dries hard. The finish penetrates into the top most layer of the wood, drying inside and on the surface. The reason this is a great guitar finish is because it gives a nice glow to an instrument, is easy to apply, and can be used by itself to completely finish an instrument.

By nature Danish Oil is a satin sheen, though it can be buffed up a little bit after it cures. If a smooth satin glow is desired from an instrument, Danish Oil is an excellent choice.



The basic process of applying Danish Oil is the same on the guitar as it is on a plain flat board, the only real differences are working on the curves of a guitar. The application is the same, however the instrument will have to be rotated on a table so all the areas can be reached.

Start with an instrument or a test board and make sure it has been sanded and leveled well, and that there are no dust bits or anything else like that on the surface.

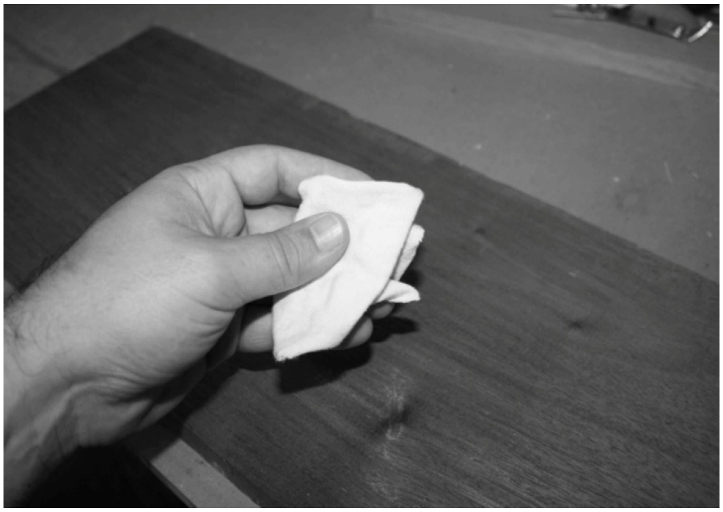
It is best to sand to 220 grit, starting with 100 grit or 150 grit to cut through the beginning sanding phases, then switch to the next finer grit,

finally ending with 220. After the 220, use a wet rag to raise the grain, and allow the wood to stand for an hour as the water evaporates from the surface. Come back with 320 grit sandpaper or used 220, and knock down all the roughness on the surface. Do not go too deeply on the sanding, just knock down the fuzz that can be felt, and sand no further.

Once the grain has been raised and the surface sanded, brush off the surface with a dry paintbrush that is only used for dust removal, or wipe it off with a clean cotton rag. This will catch all the fine dust that was left behind from the sanding process, and leave a clean surface to finish.

Watco Danish Oil comes in small, medium, and large cans, though a small or medium can will do several guitars. It comes in a variety of colors, however the natural color is the best choice for guitar making, because it does not contain any pigment.

If the Watco brand is not available, find another Oil/Varnish blend by asking at a fine woodworking store. There are several products that are Oil/Varnish blends, and they should work about the same as the Watco.



The best applicator for this finish is a piece of cotton cloth that is at least 5" x 5" and folded into a small rubber. This is essentially a several layer pad that is created to hold finish in reserve inside the pad, as well as apply it to the surface.

Fold the cloth in half several times until it is about the size seen in the above picture. Pull any lint or fuzz off of it as it is folded, and try to tuck in the ends. Once the pad is made, it will be very easy to apply finish to the pad, then use it to transfer the finish to the surface of the wood.

Swirl the contents of the can around for a minute or so, making sure that everything is mixed well before beginning. Do not shake the can,

and make sure the lid is on tight while swirling so nothing in the shop gets an accidental coat of finish.

To load the pad, cover the mouth of the now opened can with the pad, then tip the can so the finish comes in contact with the cloth. Give it a couple seconds to soak in, then remove it from the can.

Bring the pad to the wood, and begin wiping it across the surface. In the beginning it does not matter at all in which direction the surface is wiped, as long as one section is done at a time.

The oil will be absorbed by the wood as it is applied, and some areas will begin to look like they are dry already. That is from the oil being completely absorbed, and will require another pass over that area to apply more. Working with the pad in one section, apply oil and wipe it around, not leaving any puddles or pools.

Once the area has an even coat, which should only take several seconds, put more oil on the pad from the can, and continue in the same manner coating the surface.

As one section is completed, the next section can be started. Make sure the surface has an even coat of oil, and that no areas have dried up from absorbing it all.

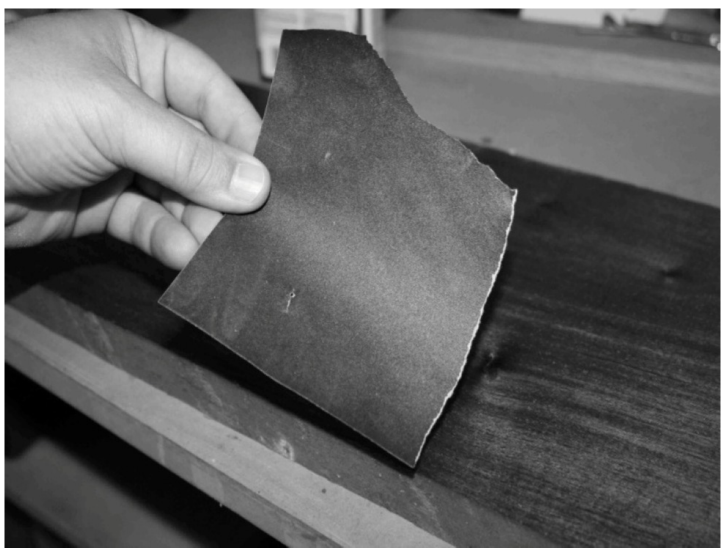
The first coat of Danish Oil will require more oil than subsequent coats, because the oil will be absorbing into the wood at a much faster rate. Dry wood will soak up oil like crazy sometimes, and it needs to be applied over and over for several minutes until all the sections remain wet, but again without puddles or pools.

After the first coat as been applied, the finish will need to dry for several hours, or overnight is even better. The best way to coat a guitar with Danish Oil is to apply a coat early in the morning, and another at the

same time in the evening. A coat applied at 8am and another at 8pm allows a full twelve hours for the first coat to dry before another is applied.

Once three or four coats have been laid down, the guitar can be left to dry for a few days and then scuffed with some 0000 steel wool to level the surface and remove any dust nibs. After that, a final super thin coat can be applied which will leave a smooth and satiny surface. Leave the instrument to cure for two weeks or more, and the finish will last a very long time.

There is an additional process that can be done to the oil finish, though it is not required to get a good look from the Danish Oil. This process involves sanding the oil while it is on the surface of the wood, which makes a slurry of sawdust that fills the open pores. This process would only apply to the back, sides, and back of the neck, since the top has no open pores to fill. It is an easy process, and will result in a pore filled final look to the finish.



This wet sanding requires a few small pieces of 320 grit wet and dry sandpaper. It is very important that it be wet and dry paper, because the paper will be getting very wet during this process. The 320 grit paper works better than very fine grits like 600 or more, because it can get more wood into a slurry faster, and still leaves a very smooth finish behind.

Immediately after the first coat has been applied, and without waiting for any drying, pour a teaspoon of Danish Oil on the surface of the wood, dumping straight from the can. Do not dump more than a teaspoon at any one time, and always spread out the new oil before adding any more. In this process, less oil is more, and too much oil can remove wood dust from the pores of the wood, which is the opposite effect we are looking for. The minimum amount of oil needed to keep the sandpaper moving around without getting stuck is all that should ever be used while wet sanding.

Begin sanding with the 320 grit paper, moving in an oval shaped motion that generally follows the grain of the piece. It really does not matter too much if the grain is not followed exactly, though following it for the majority of the sanding is best.

This is where a bit of hard work is required, as it will take time and elbow grease to get a good slurry of oil and wood dust created. This sludge of dust and oil is driven into the pores where it will dry, effectively filling them. This is a far better wood color match than any filler product could ever hope to achieve, since the filler is coming from the exact same piece of wood.

As the wood takes in more oil, and as the solvents evaporate, the slurry will get thicker and it will become harder to move the sand paper around the surface. When this happens, drip about half to a full teaspoon of oil on another part of the surface, and begin sanding in that area.

Essentially, once the oil on the surface picks up enough sanding dust, it will thicken and start being driven into the pores. This looks on the surface like the oil is disappearing, but it is actually a sign that the process is working.

Move to another area, add a little oil from the can, and sand vigorously in this new area, creating a paste that will be driven into the pores.

Proceed all around the surface in the same manner until there are no further surfaces needing sanding. Inspect the piece by holding it at an angle against a light source, which will show how well the pores have been filled. They may not be totally filled at this point, but a second wet sanding can be done later if that is the case. Normally, this process works very well the first time, and touchups are not always necessary.

The slurry can be seen on the above picture as it builds up on the surface. The sandpaper will hold some of it as well, however make sure it does not form corns on the paper. This happens when there is not enough oil on the surface, and the sawdust gets stuck on the paper, which will mar the surface. Keeping enough oil on the sandpaper will prevent this from happening, though if any corns are detected the piece of sandpaper should be replaced immediately.

Check the sandpaper from time to time, as this will be an easy way to see if there is any corning, and also to see if the slurry is being created. A little slurry on the sandpaper is a good indication that the process is working.

Once the entire surface has been sanded, wait about ten or fifteen minutes until the finish starts to tack a little, and then wipe the excess slurry off of the surface of the wood. This is done to alleviate some of the sanding that will have to be done later, and should be done with a rag and perpendicular to the grain. If the grain is followed, the rag will pluck out the majority of the filler that was just created, making all the effort up to this point a complete waste. Wipe gently, trying to grab anything on the surface, but do not press too hard. The goal is to remove only the top most layer, and nothing else.

Leave the piece to dry overnight or for at least 12 hours before repeating the process again if there are areas that need more filler. If the fill is satisfactory, simply coat the surface with a very thin oil coat, and let it dry another 12 hours. Repeat these super thin coats every 12 hours until 3-4 more have been applied in total on top of the sanded coat.

Let the piece dry for a few days to a week, and then smooth it out with 0000 steel wool until a uniform surface has been created. A final very thin coating of oil is an optional last step, and will leave a slightly glossier final surface.

The Danish Oil surface is a very traditional looking hand applied finish, and can be left exactly as it is for many years. However, if a more durable top coating is desired over the Danish Oil, a wiping varnish can be applied over it.

See the section on using a wiping varnish in this chapter for the exact instructions on application and drying times, however the basic

process is a simple one.

The Danish Oil is given a couple weeks to completely cure, and then the varnish is applied with a rag, in coat after coat until a layer has been built up on the surface. This top layer can be sanded, rubbed out, or buffed after it has cured, and many gloss options are available.

Varnish is a tougher wearing finish than the Danish Oil alone, and they really complement each other as a color enhancer and a protective top coat.

WIPING VARNISH

A regular varnish that is thinned to about half its normal strength with mineral spirits is called a wiping varnish. The reason for the extra thinner is to slow down the drying time, and allow it to be applied with a rag without becoming tacky too fast.

Thinned varnish has been around almost as long as varnish has, though in the beginning it was woodworkers thinning their own varnish at home to help them apply it better. Companies caught on, and they started producing the product for sale.

There is not a single product out there labeled wiping varnish, so going to the store and looking for it will not help very much. The only product that comes close to truth in advertising is Watco Wipe On Poly, which is a polyurethane varnish that has been thinned for wiping.

Products that are a wiping varnish can be found by asking a professional at a fine woodworking store, or specialty finish store. Internet research will also sift out the right products, though it may take a little longer. There are a few products that are definitely wiping varnish, and they are Waterlox Original, Watco Wipe On Poly, and Arm-R-Seal by General Finishes. Any of these will leave a similar surface behind, with about the same easiness of application.

Though wiping varnish can be applied directly to bare wood, it is a good idea to lay down some sort of oil based finish that enhances the coloring of the wood and pops the grain. The real beauty in a piece of wood requires an oil to truly unlock it, and then the varnish can seal it once it has fully cured.

This board in the pictures is from the Danish Oil explanation earlier in the chapter, and has cured completely for a couple weeks. The surface has been rubbed with 0000 steel wood to smooth it out, and all the sanding dust wiped off with a rag. This board is now ready for a wiping varnish as a protective layer, which the Danish Oil does not do very well. In this manner the Danish Oil will give the wood warmth and beauty, and the varnish will give it hard wearing durability.

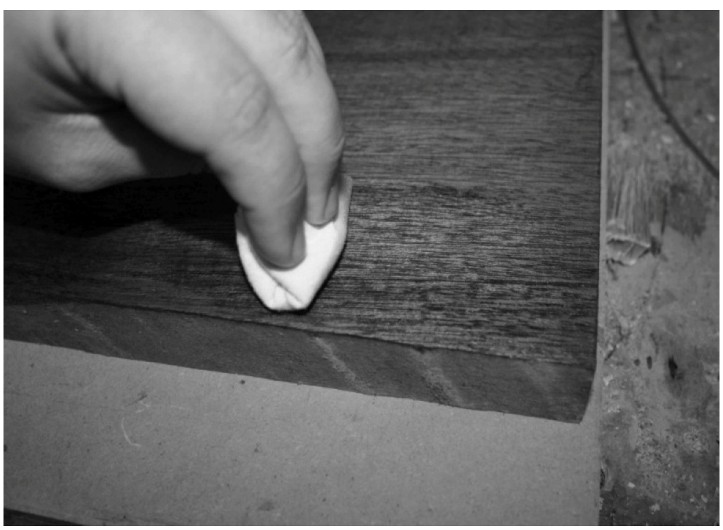
The wiping varnish used in this example will be General Finishes Arm-R-Seal. This product is available in most places, and comes in a few different gloss levels. Every varnish made is high gloss at the beginning, it is just the nature of the chemistry. To reduce that sheen the manufacturers add flatteners, which are essentially small particles that distort the light being reflected from the surface.

Use the gloss or the semi gloss on a guitar, because it is far easier to knock down the gloss on a guitar with some steel wool than it is to buff up a satin finish for more gloss. Besides, a very thin gloss coating can be further polished to an extremely high gloss with rubbing compound or a buffing setup, making the guitar so shiny it looks like it is wet.

Before opening the can, swirl the contents for several seconds to mix them all together. Some settling can happen over time with a finish, and swirling every time before using the product will ensure that the proper mixture is being applied.

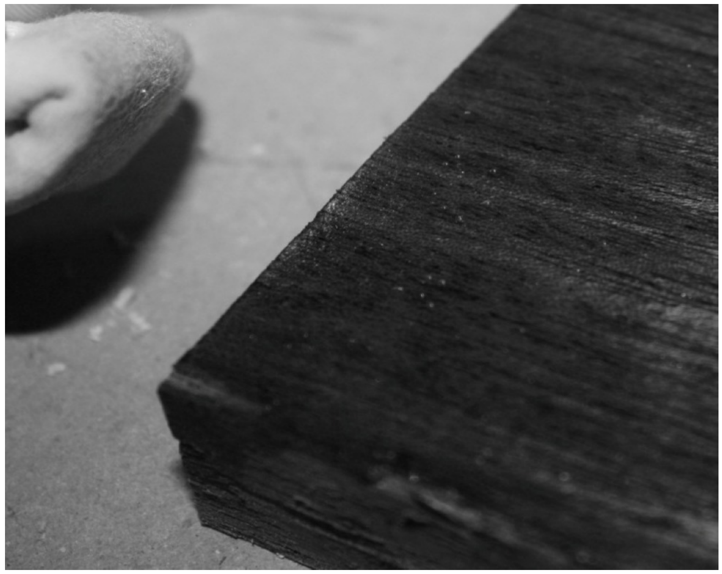
Fold a piece of 5" x 5" clean white cotton cloth into a small bundle, and dip it into the finish lightly. Only the last third of the cloth should be coated with finish, allowing the fingers to use the cloth without getting finish on them.

Allow the cloth pad to absorb a little finish, and remove it from the can before it fills past one third. Rubber gloves can also be used to prevent the finish from contacting the fingers, though it will be easy to wash off.



Bring the rag to the wood, and start coating the surface in a small section. The rag will deposit varnish on the surface and will also remove it when wiped again. Leave only a very thin coating behind with the rag, wiping with the grain, and spreading the varnish well before going back for more from the can.

Continue working around the piece, expanding the finished area and applying a very thin and even coat. A small desk light placed at one end of the piece will help identify pools that might have accidentally been deposited, and they can easily be wiped off with the rag. Since there is a large amount of thinner in the mixture, going over an area already coated will not be a problem, as it will take a long time for the surface to dry. If an area needs more attention after it has already been covered, simply go over it again and make it right.



Sometimes even with a rag, bubbles will show up in the finish. It is usually from pressing down too hard on the rag, but they can be easily removed. Go over the bubbles with the rag again, pressing very lightly. This will knock down the bubbles, and prevent them from drying into the finish.

Look at the container to be on the safe side, however most wiping varnishes will need at least 6-8 hours to dry between coats, sometimes longer. It is well worth the time spent though once the finish has been built up to a nice gloss.

Apply finish every 6-8 hours in very thin coats until somewhere between 3-5 coats have been applied to the guitar. Scuff the surface well

with 0000 steel wool, and wipe off the residue with a rag. Coat again with a very thin and even coating, and let it dry. If the look is deep enough, stop there. If not, add a couple more coats and scuff again before adding one last thin final coat. Cure for two weeks before handling.

SHELLAC

Shellac is as old of a finish as they come, with a track record that spans thousands of years. The substance comes from the Lac bug, which is indigenous to India and Thailand. This bug is very small, in fact smaller than a pea, however millions and millions of them secrete this sticky brown substance all over the bark of trees. The dried brown shellac is then scraped off the tree and processed into the shellac flakes we see in the stores.

Shellac that is scraped off the tree contains pieces of tree bark, sticks, dirt, and other foreign matter. This is all put into a cloth bag and heated in order to melt the shellac. The bag acts as a filter, separating the melted shellac, and it is then cooled into bars and thin sheets. These are broken into flakes or sold as-is and later turned into flakes.

There are a few different colors of shellac, and two basic types. The best shellac to work with for guitar making is de-waxed shellac, where the large wax content has been removed before being made into flakes to be sold. As far as the colors go, an amber shellac or orange shellac will add a subtle patina and give a warmth to the instrument as it is applied. The colors range from Garnet, which is the darkest, to Super Blond or Clear, which has had the color bleached out of it.

For all guitar work where a subtle amber glow and an easy to apply finish is desired, use an amber or orange de-waxed shellac, sold in flakes. These flakes will keep almost forever when stored in an air tight glass jar, and can be used when needed to make custom strength batches of shellac.

In order to use shellac as a finish, it needs to be mixed with denatured alcohol and dissolved into a solution. The alcohol used does not have to be denatured (hardware store) alcohol, though it will save money on materials. The difference between denatured alcohol and ethanol alcohol, which is like Everclear, is that denatured alcohol has had another chemical added to it, making it poisonous to humans and animals. This poisoning gets the product around paying alcohol taxes, because it cannot be consumed for fun anymore. The no-fun variety called denatured alcohol will work well with shellac, and not smell terribly bad either.

Denatured alcohol comes in the familiar rectangle cans and is sold in hardware stores and home improvement stores, normally in the paint section. It can be purchased inexpensively, and the larger cans give a little discount for buying in volume.

Shellac Mixing Table

D.A.	1 lb. cut	2 lb. cut	3 lb. cut
32oz.	1/4 lb. Flakes	1/2 lb. Flakes	3/4 lb. Flakes
16oz.	2 oz. Flakes	4 oz. Flakes	6 oz. Flakes
8oz.	1 oz. Flakes	2 oz. Flakes	3 oz. Flakes

Mixing shellac into alcohol requires a little math, and a little understanding about how much shellac will end up in the solution. The cheat sheet above shows the common three strengths used, and how to get the right proportion of shellac flakes and alcohol.

The amount of shellac in a solution is referred to as the cut. A one pound cut of shellac is literally one pound of shellac in one gallon of denatured alcohol. A two pound cut is two pounds of shellac flakes in one gallon of denatured alcohol. The cut is a measure of how much shellac is in the mixture, and does not need to be made by the gallon to get the math right. In order to have a uniform method of calculating the shellac mixture, a gallon is simply used as the base measurement.

For example, half a gallon of alcohol with one pound of shellac in it would be the equivalent of a gallon of alcohol and two pounds of shellac, which would be a two pound cut. The same can be done for small batches like 8 ounces of alcohol and 2 ounces of shellac flakes. This is also a two pound cut, just much less than a gallon is being made at one time.

The denatured alcohol is poured as a measurement of volume and the shellac flakes as a measurement of weight, so use a measuring cup for the alcohol, and a small digital scale for the shellac. A food scale will work great as well, even a non digital model. The only difference being the tare feature, which can be worked into the math on the non-digital scale, and will be explained later.

Purchase a small food scale of either variety, which can be found in any supermarket or kitchen gadget store. It is wise to buy an inexpensive model, because it will only be used for measuring and mixing

shellac most likely. It is usually a difficult task to borrow the kitchen scale for these kinds of projects, so it is best to have a shop scale that can be spilled on and ruined without any consequence.

In this example, a two pound cut of shellac will be made, using a small glass canning jar with a tight fitting lid. Fill the jar with 8 ounces of denatured alcohol, using a measuring cup for accuracy.

Once the denatured alcohol has been measured out and put into the jar, replace the lid on the alcohol container and put it in a safe place where it cannot fall over or spill. This product is very dangerous for the eyes and should be treated as a such when working with it.

Using the scale, the shellac flakes will need to be weighed out. A small bathroom cup or Dixie cup is a great holder for the shellac flakes while measuring, and will typically hold an ounce of the dry flakes when almost full.

The weight of the cup or container being used will need to be subtracted from the weight of the flakes to get an accurate reading. In the event a coffee cup or something very heavy is used to hold the flakes, this will be much more important than a few gram plastic bathroom cup.

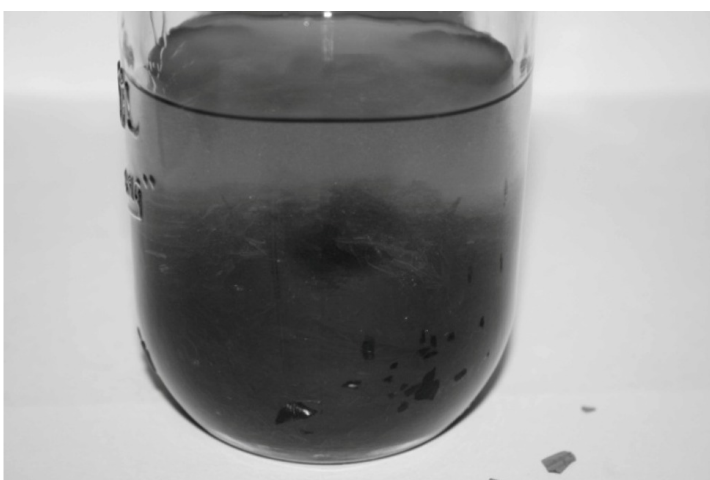
If using a digital scale, place the empty cup on the scale and wait for it to register a weight. Press the tare button to zero the scale with the cup on it, effectively subtracting the weight of the cup from the measurement. Then, slowly pour shellac flakes into the cup until it reaches one ounce, putting some back into the main container if it is overfilled.

If a manual scale is used, place the cup on the scale and adjust the pointer back to zero by turning the adjustment screw. A heavier cup like a coffee cup will be easier to adjust than a very light plastic cup, because it will have a more definitive reading.

Once 2 ounces of flakes have been measured, pour it into the jar full of denatured alcohol. If a small cup has been used, pour two cups (each weighing one ounce) into the alcohol, trying not to spill as many flakes as the pictures show. If any flakes do spill, they can simply be picked up and dropped into the jar. If a little dust or something gets into the mixture, it will be strained out later.

When the flakes first enter the alcohol, they will not look like they are going to do anything. They can be heard if the jar is swirled a little, and they sound like small pieces of glass being stirred around. The alcohol will take a few hours to break down the shellac, and suspend it into the mixture. Place the lid on the jar, and close it down tightly to prevent any accidental spills.

Every 30-60 minutes, the jar will need to be swirled to ensure that the shellac flakes are mixing into the alcohol, and not just forming a large sticky lump at the bottom. Swirl the jar or shake the jar to agitate the contents, and encourage the shellac to break up and dissolve well.



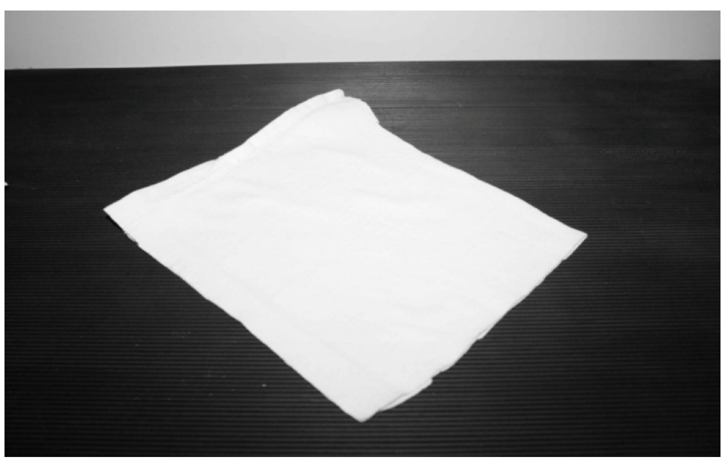
After the initial shaking, some darkening can be seen near the top of the liquid line, but the majority of the shellac is still in flake form on

the bottom of the jar. Most of the initial discoloration comes from dust and foreign matter in the shellac, and not the actual shellac itself. Still, swirl the contents as soon as the lid is in place, making sure to get all the shellac flakes good and wet so they will dissolve. Place the jar in a room temperature location out of direct sun light, and allow the alcohol to break down the shellac flakes.

The above picture shows what will happen as the shellac is broken down by the alcohol. The flakes will get jelly like and settle to the bottom and stick there if they are not shaken from time to time.

Shake the bottle every half hour to an hour for a few hours, until all of the shellac has been taken into the alcohol, leaving behind a solution of a uniform brown coloring. There will still be some bits and gunk on the bottom, pieces of wood and twigs and the like. These will be removed later before the shellac is used.

When the mixture reaches a coloring and evenness that can be seen in the above photo, the shellac mixture is just about ready for the next step in the process. Check the bottom of the jar and make sure all of the flakes have been incorporated into the mixture, and that the only remnants left behind are foreign matter to be strained out later.



To strain the mixture, a piece of cotton cloth or dye free fabric is needed. Cut the fabric into a square about 8" x 8" using a scissors, and make two of them. This fabric will be used to collect the foreign matter in the shellac, straining it into a new jar.

Place the center of the fabric over the new jar opening, and use a rubber band to keep it in place. Leave a little extra material over the mouth of the jar to help contain the liquid.

Press a finger into the center of the cloth, pushing some of the excess down into the jar. Press a couple inches of fabric into the jar, which will contain all the debris to be filtered out.

Tip the shellac mixture from the original jar into the new one, slowly pouring the contents. If the mixture pools up, stop pouring a little bit and allow it to make its way through the fabric before pouring more.

The deeper the well of fabric inside the jar, the more shellac can be poured at once into the second container. Do not make it deep enough however to touch the strained shellac once it is poured through, otherwise it will not strain well. A couple inches of fabric is perfect.

Allow the strained mixture to sit for a minute or so, to allow the last of the liquid to work its way through the cloth, then carefully remove it. Removing the cloth should be handled very carefully because the alcohol can splatter, and safety glasses should be used at all times when handling finishing products.

Looking at the inside section of cloth after it was removed from the jar, the amount of particles and un-dissolved shellac lumps can easily be seen. These chunks and pieces of debris would have made it into the final finish if they were not removed, and they would have had to be sanded off after the finish had dried.

A good method of preparing this rag for the trash is to take it to a utility sink and run water through it for several minutes, pulling the alcohol as well as the shellac out of the fibers. This will dilute the alcohol, as well as prevent the rag from building up heat as it dries.

Once most of the smell has been removed from the rag, it is safe to ring out and drape over the faucet of the utility sink. Here it will have ample space to dry out, and once it is bone dry, it can be placed in the trash safely.

Cap the strained mixture immediately, and use a permanent marker to write a few important items on the lid. Record the date the shellac was made, the cut, and what brand of shellac flakes were used. All of this will be hard to remember down the road if the mixture is something that works well and needs to be duplicated.

Shellac can be used right out of the bottle as soon as it has fully dissolved and the mixture has been strained. The easiest method of application is a rag that has been folded over several times, dipped in the shellac and rubbed across the surface.

In preparation for shellac application, sand the wood to 220 grit, and wipe away all the sanding dust with a dry cloth. Inspect the surface for imperfections and fix them with sandpaper or a cabinet scraper.

Raising the grain is not necessary with a shellac finish because the alcohol does not raise the grain like water does, however as a precautionary step, raising the grain and knocking down anything that pops up is a good idea. Once the guitar is ready, the finishing process can begin.

Cut a piece of clean white cotton cloth that is about 5" x 5" and fold it over on itself a few times, making a small fabric pad. Dip the pad into the shellac, and allow it to absorb some of the finish and become very wet.

An alternate method that is sometimes easier than dipping into a jar, especially if the mouth is small, is to use a squeeze bottle. These come in several sizes and are made from plastic. They can have a small amount of shellac mixture poured into them, and it will dispense through a nozzle somewhat like a mustard bottle. These are found at fine woodworking stores, and can be washed and used again later on.

Begin in one area of the guitar, and start to transfer finish to the surface. Wipe it with the grain as it is applied, dipping the rag back into the jar as often as needed. The first coat will require several dips into the jar, or several squirts with the small bottle directly onto the rag.

Allow a good amount of shellac to flow onto the surface, wiping it up immediately with the small cloth pad. Since the pad will contain a certain amount of shellac, pressing a little harder will dispense more from the pad, allowing it to be stretched farther onto the surface. Once the pad will no longer give up any more shellac, add more to the pad. Continue to work one section until it has been fully coated before moving on to another section.

The above image shows the piece being demonstrated, and it is about half way coated with the shellac solution. Working with the grain, more and more is applied.

The interesting thing about applying shellac is the speed at which it dries. When a part of the guitar or piece of wood is completely covered in shellac, the part where the process started is usually dry, and can take another coat. Alcohol evaporates very quickly, making a second and third coat quick and easy to apply.

In one session, several coats can be laid down, usually in the neighborhood of four or five depending on the cut of the shellac. Thicker batches will require more drying time, because there is more shellac being applied in each pass. The down side is that a thick batch is sometimes a pain to control, and can be applied too thickly in some places and too thinly in others.

Coat and re-coat the surface, always starting at the same place and ending at the same place. If the finish gets a little sticky and hard to go over again, stop and let the surface dry for a few hours before going back and coating again. Repeat this process several times until the sheen and the amber coloring are satisfactory, and then allow the piece to dry completely overnight.

Smooth out the surface with 0000 steel wool, and wipe the guitar clean with a piece of cloth, removing all the shellac dust. Apply a couple more coats very thinly, and allow them to dry overnight again. Once

the surface is totally dry, a very light smoothing with the 0000 steel wool will leave a smooth and hard surface.

The full cure for shellac should only take a few days in the house, and it can then be handled freely and played. Shellac can be buffed to a very high gloss with buffing compounds and wheels, however it takes a careful hand not to burn though the shellac. If the guitar is going to be buffed, use a low RPM buffer and move the piece quickly to avoid digging completely through the finish and hitting the wood.

Shellac is a wonderful finish and it has the history and nostalgia of a several thousand year old technique. Those who use shellac are following in the footsteps of generations of great instrument makers, craftsmen, and woodworkers. There are over 3000 years of history in a jar of shellac, and it still adorns the fine furniture in many museums.

There was a time when the only way to get the ingredients for a shellac finish was to go to the apothecary and buy the materials. These were the drug stores of their time, selling all manner of interesting chemical and herbal products. They sold items that sound like they are from a witches brew like dragons blood, copal resin, gum spirits, pine resin, and mastic. These were combined by the master instrument makers of the time and made into their varnish.

Using shellac today is a much easier process than it seems, and the only real difference between this and another finish is that this one needs to be made before it can be used. It is much easier now than it was years ago, when the old masters did it, and for that reason it is worth a try.

There are a few tips that will help along the way when using shellac, and they will make the process easier and faster.

Mix Small Batches of Shellac

There is absolutely no reason to mix a gallon of shellac, unless it will be used to finish an entire boat, and a large one at that. Mixing smaller batches in the 8-16 ounce region will make the process much easier, especially when it comes to getting all the flakes to dissolve.

An eight ounce batch of shellac will do an entire guitar and have some left over to do the next guitar. Smaller batches are easy to work with, and waste less shellac in the long run. Once shellac is mixed, the countdown on the shelf life of maybe six months to a year begins. After this time, the batch must be discarded and a new batch made.

Mixing in eight ounce batches has another advantage that newer shellac users will especially appreciate. When mixing into eight ounces of shellac, one ounce of flakes makes a one pound cut, two ounces makes a two pound cut, and three makes a three pound cut. The math is very easy to remember, and for most of us this will not require breaking out the calculator.

Grind Up The Flakes

If a faster mixing time is needed, the flakes can always be ground up before adding them to the denatured alcohol. Purchase a small coffee grinder or mini food processor, and use it to grind up the flakes into a fine dust. Place them directly into the unit, adding nothing else, and pulverize them for a few seconds. Dump them into the alcohol and they will dissolve much faster.

Be sure to measure the amount of flakes before pouring them into the processor, adding a very small fraction for the dust remnants that will be left behind when the contents are poured out. Also, make sure to write in permanent marker that this food processor is for shellac flakes only. Shellac itself is not dangerous to consume, and in fact it is used on many things we eat and fruit we buy to make them look shiny and more

appealing. The taste however is something I cannot vouch for, and it is sure to color whatever goes into the food processor the next time.

Shellac does become dangerous to consume when mixed with a solvent like denatured alcohol, which contains a poison. The flakes themselves are a natural product, and cannot harm anyone in very small doses.

Strain Shellac Before Using

It only takes a couple minutes to run the shellac through a piece of cloth to catch all the dirt and twig remnants in the mixture, but it make a huge difference in the finish. Having to sand through a chunk of bark, or having a dark piece of wood deposit coloring on a bright white soundboard is not worth saving three minutes and one shop rag.

Strain the mixture after it has completely dissolved, and do not return it to the same jar. Keep the strained mix in the new jar, that is contaminant free and gunk free. The old jar can be rinsed with denatured alcohol and then water, and used again to mix more flakes in the future.

Canned Shellac Has Wax In It

The best shellac for instrument makers is de-waxed shellac, which unfortunately does not store well in the can. The canned variety is almost always wax containing, and needs to be treated differently.

If the shellac finish is the only thing going on the guitar, a canned mixture (which are normally three or four pound cuts) can be used. When a finish is applied over shellac that has wax, sometimes it has a hard time adhering. When layering finishes, de-waxed shellac is the only safe way to go.

The canned shellac types offer some convenience in the sense that the stuff is ready to go as soon as the lid is removed, however the down side is the thicker mixture usually fights a little more when being applied. The canned stuff will tack up very quickly, preventing more shellac from being applied in the same session, and it will also take longer to dry fully because of the wax content. When it does dry, it inevitably leaves thicker and thinner areas that need to be sanded even, which does take some time.

More time can actually be saved by using flakes and mixing a thin cut of two pounds or less and just applying a couple more coats.

Use Weaker Cuts and More Coats

The temptation is always there to speed up the process somehow, and we all convince ourselves that if the math adds up, that what we are about to do must work. Common sense would say that a thicker finish would require less coats, and finish the instrument faster and better. This is like saying that baking a pizza for 40 minutes at 300 degrees will have the same result as baking a pizza for 20 minutes at 600 degrees. When applied to another subject the insanity is easy to see, yet everyone tries heaping on a thick finish at least once.

Use a thinner cut of shellac. It will apply easier, dry faster, and leave a smoother surface than applying thicker coats. A 2lb. cut is the best to use for all Shellac finishing.

Make Custom Colors

Make a couple small eight ounce batches of shellac, and try mixing aniline dyes into them for added color. Alcohol soluble aniline dyes come in small squeeze bottles, and the intensity of the color can be varied by adding more dye or not adding as much. It is always easier to add a second coat to get a darker color, so lean on the lighter side. Removing color can be done with a rag and denatured alcohol, but it is not always easy or even looking in the end.

Count the number of drops added to the shellac, and write that on the jar lid with the rest of the shellac information. If the color needs to be increased, add a couple drops or just coat the piece a few times. Colors can be mixed in the same batch of shellac for a blended look, just make sure to record the number of drops of each color. If something amazing looking is discovered, knowing how it was made will make doing it again much easier.

Apply With A Rag

Shellac will apply smoother, dry faster, and finish easier if applied with a clean cotton rag. There are very soft brushes out there that are great at flowing shellac onto wooden projects, but a rag still makes the best application method.

When applying shellac with a rag, the simple act of wiping the surface levels and smoothes out the finish, making the next coat even easier

to apply. A brush will tend to deposit more shellac on the surface than needed, and it will take longer to dry because the film is thicker.

When applying with a rag it is almost impossible to accidentally put too much finish on the guitar, because the rag will soak up the excess every time. Plus, the rag itself can control the amount of shellac deposited and removed with each wipe.

A rag will be a little slower at first, requiring more coats, but it will win in the long run with a finish that will need only a little bit of smoothing with steel wool to be flat and professional looking. With finishing, the long road is actually the short road, and there is no need to speed things up.

BOILED LINSEED OIL

A traditional finish that still has much popularity today is Linseed Oil, specifically Boiled Linseed Oil. The difference between regular raw linseed oil and boiled linseed oil has nothing to do with heat, and more to do with added chemicals to help the oil dry. Metallic dryers are added to the oil, and they help the finish dry in a day or two rather than between several weeks and never.

Raw oils like Linseed Oil, Tung Oil, and Walnut Oil take an extraordinarily long time to dry, and they never really seem to dry completely. Adding the drying compounds to the mixture helps the process by making the finish dry in a day or two, and cure in a couple weeks.

The most basic version of boiled linseed oil can be found in the hardware store in the classic rectangular can. The product is ready to use exactly as it is, and only requires a little swirling of the contents before finishing.

Apply boiled linseed oil the same way as any other wipe on finish, using a clean white cotton cloth, and working in one section at a time. It does not matter at first which direction the oil is wiped on, as long as the last few passes are with the grain. As the oil is taken onto the surface of the wood, add more to the cloth before bringing it back to the wood to oil another section.

Control the volume of oil applied by making sure the pad is not too wet, and that any excess or puddles are wiped up immediately and then deposited elsewhere on the board. The pad itself can be used to both deposit as well as mop up oil, depending on how hard the pad is pressed. A very thin coat of boiled linseed oil will dry in a reasonable time, where a thick coat will stay tacky for days and maybe never dry at all.

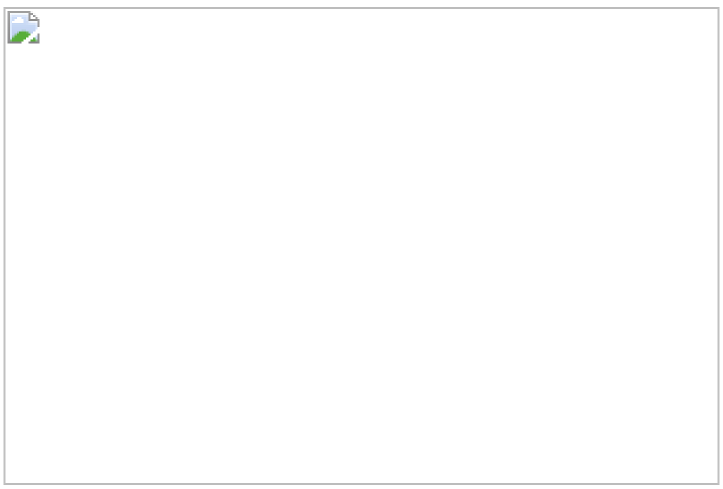
Due to the nature of the product, there is really no benefit from applying multiple coats, since this finish cannot be built up to a thickness like varnish or polymerized oils can. Where this finish excels is in the ability to pop the grain and bring out the hidden beauty of a piece of wood.

If boiled linseed oil is going to be used, it is best used for its beauty enhancing properties, then coated over with a harder wearing finish like a wiping varnish. This way the beauty of the oil comes through, and the protection of the varnish also adds something to the mix. Each part of the finish gives something that the other part cannot, making them a perfect pair for finishing a guitar.

Boiled linseed oil by itself makes a very basic finish that will need special handling and care to keep looking nice. Water can seep into the wood through the finish, causing problems and white areas. Also high humidity areas can allow water vapor to do almost the same thing. If using this finish, make sure to allow it a couple weeks to cure, then cover it with a much stronger top coat.

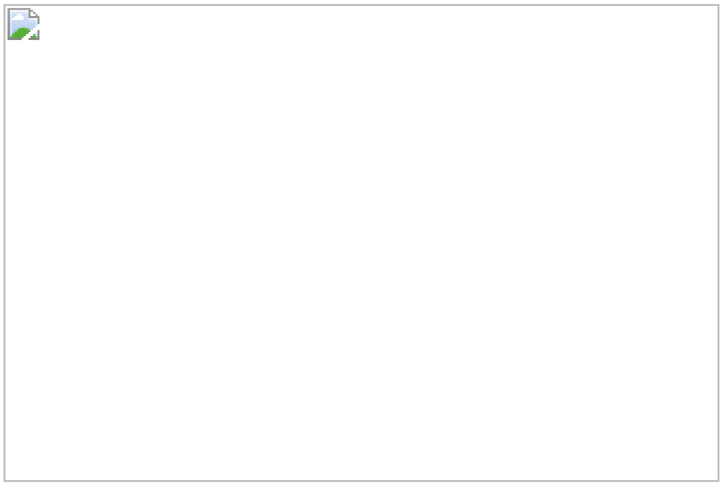
CONTRAST STAINING FIGURED WALNUT

A great looking piece of wood to make an extraordinary acoustic guitar bridge from is figured Walnut. This can be found in most hardwood stores if they sell Walnut, and can be ordered online. The pieces found in the hardwood store will range from light to heavy figure, though the pieces bought online can have tremendous figure and a corresponding price tag. Try finding the piece in the local wood store before looking online, which will save some money.



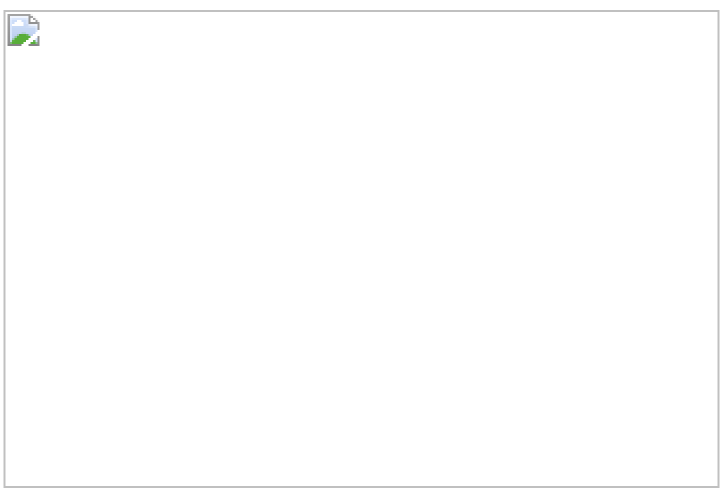
These cutoffs were found in a local woodworking store, and were in a large bin containing several hundred. They were fairly inexpensive as far as figured wood goes, and they have a nice look to them.

Any one of these will make an excellent guitar bridge, and contrast staining it will help bring out the figure and the depth even more than it already is. A board like this is a great starting place, because the grain is already so much more pronounced than a less figured piece.



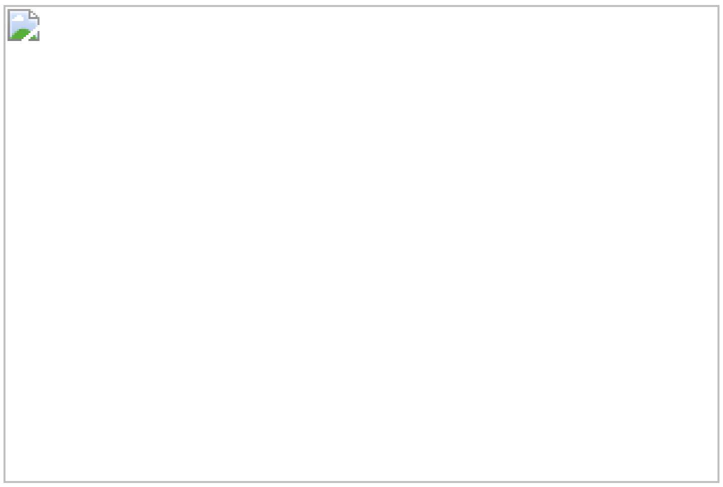
A contrast stain is essentially a stain that is applied very dark, then most of it is sanded away. The stain sucks into the end grain more than the face grain, which stays behind after sanding. This increases the contrast, bringing out the grain further. The pictures here will show the contrast staining process on a larger piece of wood, which will highlight the effect the technique produces. When doing this to a guitar bridge, it will need to be a completely carved, drilled, and sanded piece that would otherwise be ready to go onto the guitar.

The first step is to sand the entire surface where the stain will be applied, and on a guitar bridge this means getting to 220 grit and carefully examining for scratches before proceeding.

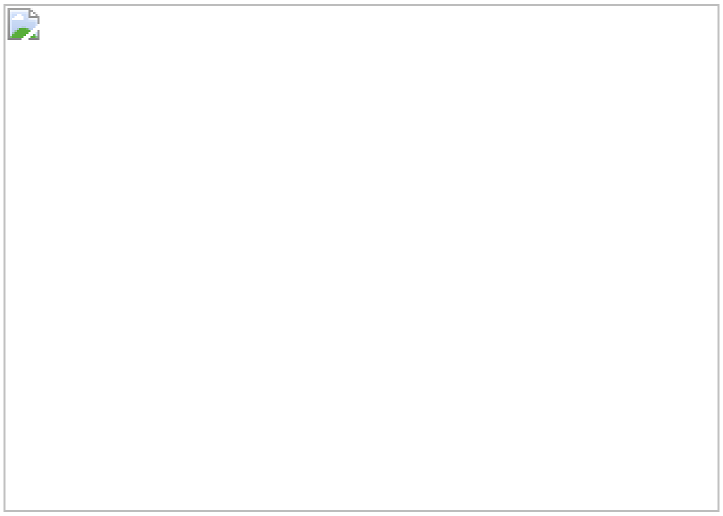


In order to contrast stain, a very dark alcohol based dye stain is needed, as well as a pair of rubber gloves, and a clean cloth to apply the stain with. In this case the stain color is dark brown, but anything dark including black can be used.

Mixing aniline dyes is very easy, and is simply a matter of adding drops of dye to denatured alcohol in a glass jar. More drops will make a darker dye, and less will make a lighter dye.

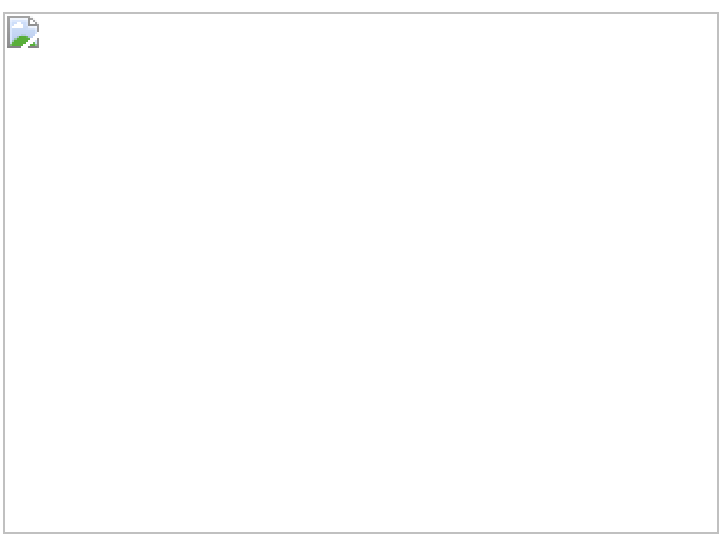


Fold up the small cloth applicator rag, and while wearing gloves, dip it into the stain and allow it to absorb some of the liquid. The pad should be about half way full of stain, which will allow it to act like a tiny dispenser when pressed hard onto the surface. It will also aid in getting enough dye onto the surface that the wood soaks up the needed amount to make the contrast.

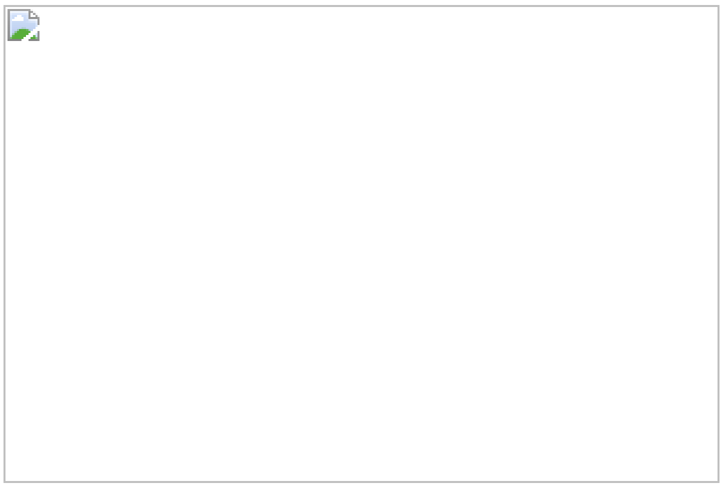


Begin wiping the stain on the surface of the wood, and in the case of the bridge make sure to wipe it everywhere except the bottom face that will be glued to the guitar. Concentrate on spreading it out evenly, and making sure that every place as been coated.

If the small pad starts to not leave enough stain behind, press a little harder as the pad is wiped along the surface. This will force more stain out of the pad, and coat the wood better. If too much is being dispensed, relax the pressure on the pad and it will not let out as much. One pad that was soaked about half way with stain should be enough to do an entire bridge and then some. When in doubt, press a little harder and the cloth should let more stain out.



The alcohol will dry very quickly, leaving the dye behind on the wood. This means that several coats can be applied in rapid succession one right after another. The picture above shows the wood after several coats, and with the top half of the board still wet. The freshly wetted half dries in literally a few seconds, and can be applied over again. This is the nice part when working with an alcohol based stain, the drying time is almost zero.



Continue to apply stain until the surface of the bridge is completely coated, and has taken on a very uniform and very dark coloring. It should look almost completely black, like if the piece were made from Ebony instead of figured Walnut.

Allow the stain to remain on the piece undisturbed for several minutes to encourage a thorough drying. The alcohol on the surface will evaporate almost immediately, however the alcohol that has soaked into the surface of the wood will need around 15 minutes to be safe.

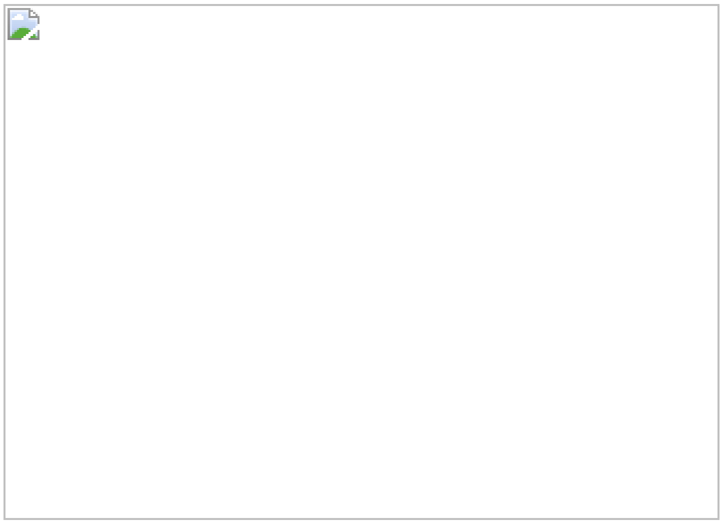
In the time that the piece is drying, gather up a flat sanding block and a piece of 220 grit sandpaper, which will be used to remove most of the color. A flat, cork faced sanding block is the best to use for the flat areas of the bridge, however a folded over piece used with the fingers will be the best for the curved parts. Take the time to sand evenly, making sure not to remove any more stain from one area than another, and always leaving a little behind. A good estimate would say that 85%-90% of the stain will be removed when finished.

Here is a look at the board once the sanding is completed, and with the dust still remaining on the surface. Notice how it almost erased the grain in the picture, which is because the dust has not been wiped off. When

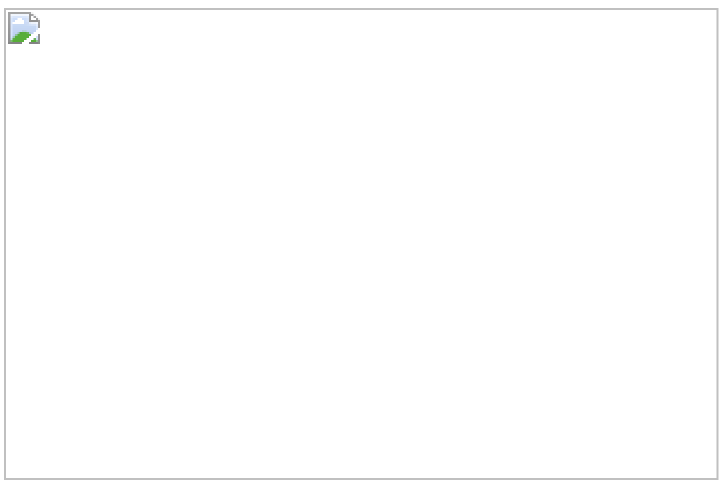
sanding the bridge, keep a dry or slightly damp rag handy in order to remove the sanding dust, and show the actual surface of the wood. Check the piece often while sanding, but do not soak it because the stain can reanimate and start coming off.

In order to really see the figure and the progress made by staining and sanding, the piece will need to have a finish applied. This can be done directly over the surface as it is right now, and it is recommended to use something like boiled linseed oil, Danish oil, or Tru-Oil which will bring out the depth even more.

If the piece is going to be buffed, as many guitar bridges are, do not apply the oil and go directly to the buffing wheel. There are instructions for making an inexpensive simple buffing setup for guitar bridges using a lathe or drill press in chapter two earlier in the book. This will be a simple process using one type of compound that will immediately bring out the color and grain.



Buff the entire surface of the bridge with tripoli compound until it has a uniform sheen and the grain pops out nicely. A few seconds in each area will do just fine, always keeping the piece moving while under the buffing wheel.



Once the piece has an even buffing, the look of the grain will really show itself. The added stain makes the darker areas darker, and leaves most of the lighter areas alone. Again, this example is done as a solid piece of wood to show more of the grain and be a better example of the technique.

A bridge will have even more detail revealed because it is carved, showing several different layers of wood depending on where it is

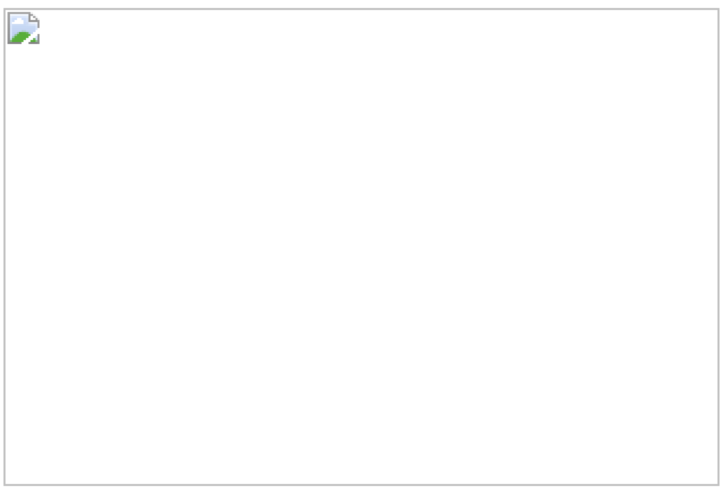
viewed from. It will be easy to see the shimmer and the color variances while the figured Walnut bridge is rotated in the light, and it will have the same effect when the guitar is played.

Many figured woods can benefit from this process, not just Walnut. Any dark and figured piece of wood is worth buying a scrap of and practicing on to see how it will look. Many wood stores have large scrap bins that can be gone through and small pieces of wood can be had for a very low price. These would normally end up in the trash, and are a great place to find small pieces to test finishes.

SIMPLE GRAIN POP ON FIGURED MAPLE

Nothing can compare with the ability of an oil to get into a piece of wood and really bring out the beauty and the depth of the figure and grain. There are many options for oils, but boiled linseed oil and Tru-Oil are some of the best choices.

This process can be done on any part of the guitar that will be made from Maple, or any other figured wood, and will add a layer of depth to the finish that has to be seen to be fully appreciated. The method involves using an oil over the surface of the wood as a base layer, or in some cases as the only finish on the instrument.



The picture above is a close up of the piece of Maple being used for this example, and it has a medium figure throughout. It can be seen from certain angles and not as much from others, and believe it or not the picture above is one where it can be seen the most. The difference between this picture and the last picture illustrate the power of using an oil coat first before anything else.

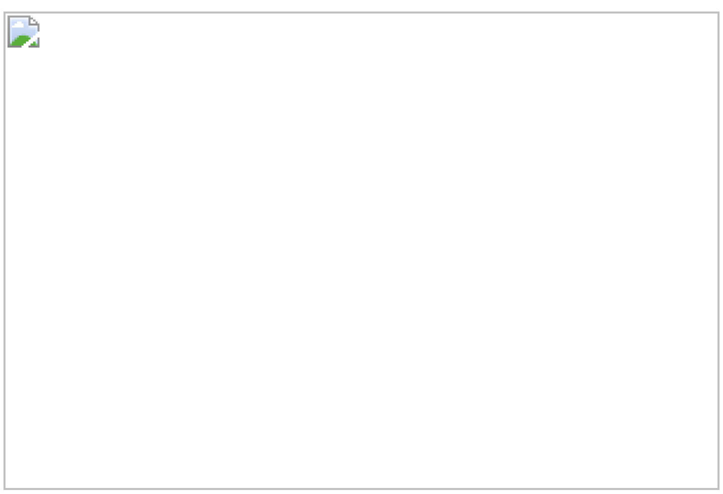
Before applying any finish, the piece needs to be thoroughly sanded or scraped, in order to remove any scratches and level out any problem areas. If given the choice, sand through as much of the problem areas as possible, and then switch to the cabinet scraper for a final smoothing of the entire surface. A scraper will cut the wood, opening more pores and allowing more oil in. Sanding crushes these openings, muting the effect of the oil slightly, so be sure to use the scraper at least in the end for the final leveling.

For this example, a bottle of Tru-Oil will be needed, as well as a small clean cloth applicator that can be cut form a clean cotton shirt. Cut

out a section that is a few inches by a few inches and fold it over several times, making a pad.

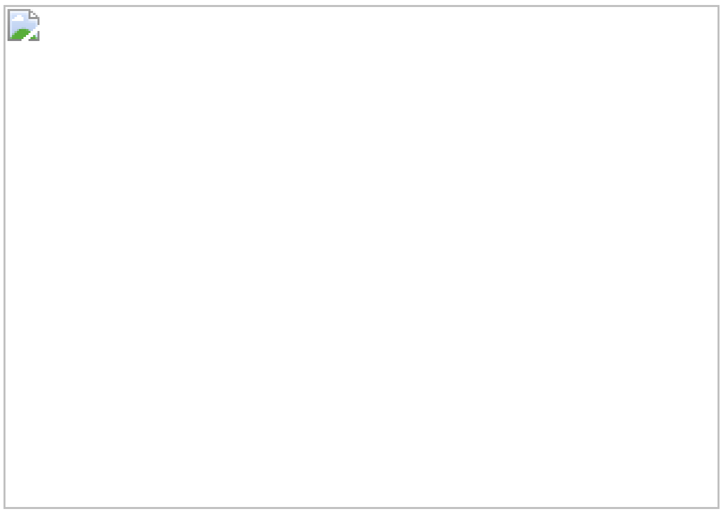
Wearing gloves, place the applicator pad on the open mouth of the bottle, and tip it slightly to deposit some oil on the rag. It is a good idea to swirl the bottle a little bit prior to opening it, and make sure there are not any solid chunks present. Once the finish looks satisfactory, it can be used on the instrument, or in this case the test board.

Once the top most layers of the pad have some oil on them, never soaking the pad completely, the process of applying the oil to the surface of the wood can begin.



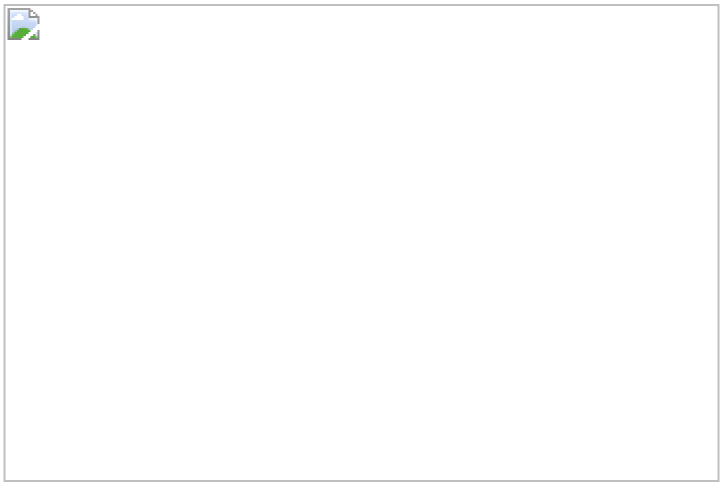
Begin applying oil directly from the rag onto the surface of the wood. It is important to keep the oil from pooling in one location, as well as not allowing the rag to create smear marks. The best way to do this is to try applying as thin of a coat as possible, as well as spreading out the finish as far as it will go before adding more to the rag.

Tru-Oil works best when the coats are kept so thin that it almost looks like hardly anything has been applied. They will dry faster, shine longer, and pop the grain better than thick and sloppy coats.

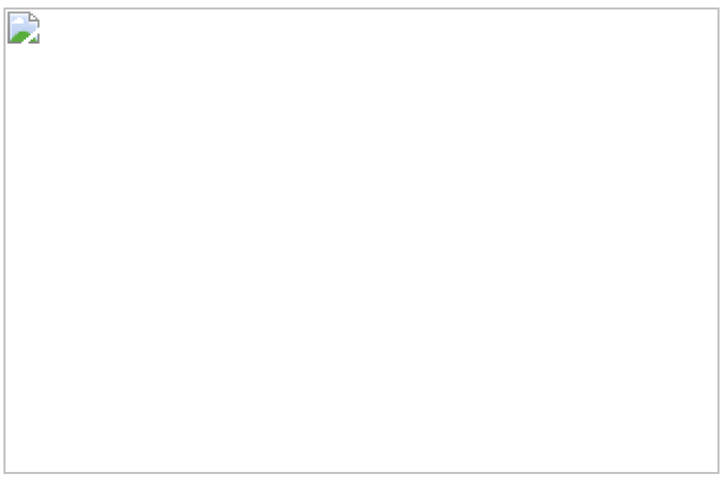


Work one side of the piece at a time, and in the event of an instrument, work one small section at a time until it is completed before moving on. The grain and the figure can already be seen coming out much more than the first picture, and this is only with the first few wipes of the rag.

Concentrate on making the coating very thin, and going over each area several times to ensure that there are no places with excess finish left on them. In the event that a run or a thicker area is found before it begins to tack, wipe that area again with the same rag, allowing the rag to absorb some of the finish. Usually this will work, and the absorbed oil can be applied somewhere else on the instrument.



The contrast can be seen much more in the picture above, where the right half of the board has been coated and the left has not. Notice how the rippling of the figure is much more pronounced.



This is the final board after a light coat of Tru-Oil has been applied to the entire surface, and the figure is almost leaping off the board. This piece was fund in a regular hardwood store among several other Maple boards. Though it was nothing special at the time, if it were used as a set of violin ribs and coated with Tru-Oil it would be extraordinary looking.

Project Notes:

Using an oil as a base coat for instrument finishing, or just using the oil for the entire process really makes a piece of wood pop. The

grain on this piece of Maple was hard to see, and inconsistent looking before the oil. Afterwards, it has shimmer, shine, and a much more expensive look than it had when it was purchased.

Oils have the power to make an expert finisher out of anyone who is willing to give them a try, and will never be matched by lacquers or other more modern forms of finishing. They only need a small rag to apply, and they give a look that has to be seen to be believed.

FINISHING TIPS & TRICKS

There are many lessons that a person picks up over the course of several years of finishing wooden projects. Though they are seemingly small, these things make the act of finishing easier, and much more professional looking.

Something as small as working in a dust free place can make the difference between a smooth finish and one full of particles that will need to be sanded completely off to fix. Simple things like using new finishing products instead of old ones, and where to store finishing supplies can make a big difference in how well a finish looks.

These little bits of knowledge normally take years to discover through trial, error, and time. The following segment will take away many of the mysteries on how to finish well, and provide some general knowledge on how to apply great finishes.

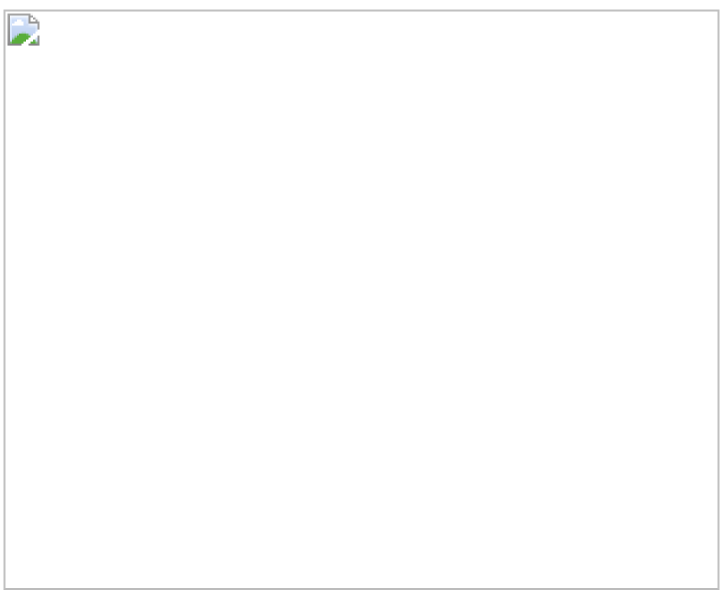
Dust Free Finishing

The simple change of working in a dust free area of the shop or the house to apply a finish will do wonders for the smoothness of a finish.

A garage that was just sanded in, or where something was sawn has millions and millions of dust particles floating around in the air, just waiting to land on the still wet finish and ruin it. Even if the floor is dusty, such as the above picture, walking on it will agitate the dust, make it airborne, and allow it to become stuck to the finish.

The best thing to do when finishing a guitar is to have a separate area where the finish can be applied and allowed to dry. This does not need to be anything fancy unless spray equipment is involved, which in that case refer to the use and safety requirements of the equipment before making a room for it.

For hand applied finishes, a spare bedroom in the house is a perfect place to apply the finish and allow it to cure. The room will have openings to ventilate the smells, a ceiling fan to encourage drying, and it will not have near the amount of dust as the shop will. A dedicated part of the shop could also be walled off or separated with plastic sheeting, however this requires far more work than simply walking to another room, and ventilation would be a project too.



Good Surface Preparation

This has been said thousands of times by thousands of woodworkers, but it is always worth mentioning at least one more time. The final finish on a project will only be as good as the surface it is applied over.

A piece of wood needs to be sanded well, be scratch free, and have no glue on the surface before it is ready to be finished. Glue on the surface prevents the finish from getting into the wood, causing a bright spot on the surface. Poorly sanded areas and scratches or blemishes are amplified by a finish, not covered up by one. Small scratches that are barely visible on the unfinished surface can be seen from space after the finish is applied.

Taking an extra hour to make sure the guitar is perfect before finishing will make more of a difference for the finish than anything else that could be done to it. The preparation of the guitar cannot be sped through in the excitement of seeing the guitar finished. It will only make the final instrument not look as good is it could have.

Once a guitar has been final sanded, wipe it off and begin examining it. Really look slowly and carefully, and do not glance over any areas. Move the guitar around to get a look at it from different angles, which will increase the chance that a blemish will be seen if it exists. Once a scratch or other blemish is found, remove it and continue looking.

After being very satisfied that the surface is scratch and blemish free, the first coats of finish can be applied.

Use Fresh Product

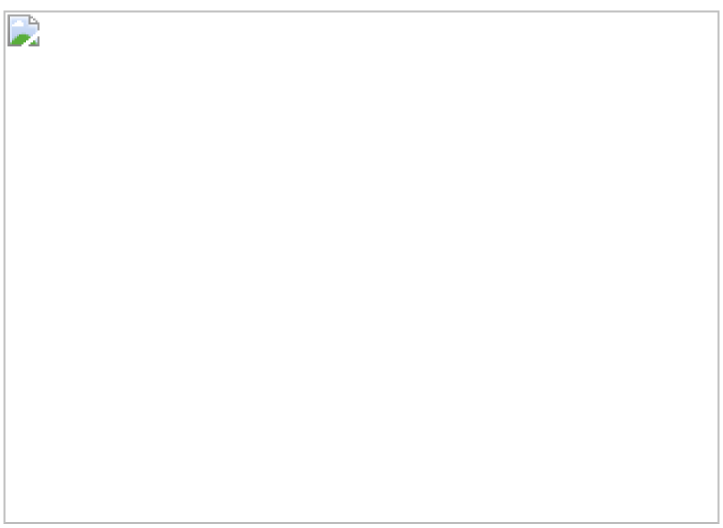
A simple but often times overlooked trick to finishing a guitar is to always use fresh finishing product. This sounds pretty obvious, but many

people still use the old can of whatever that has been sitting in the garage for decades. Finishes typically last a long time unless many projects are being made, and the temptation to keep half a can of old finish to save a few dollars is not worth it.

Most people do not finish enough projects or make enough guitars to go through a large amount of finish. Typically, a single container of finish no matter which, will be enough to do several guitars with. The product is not cheap, so the thought is to save it for next time, even if next time is a couple years down the road.

Once a container of most finishes has been opened, the contents start to deteriorate. This is in the form of hardening, chemical breakdown, and skinning over on the top. These can be delayed by storing the products well, which will be covered later, however a good rule is to toss anything after a year, or after the expiration date on the can, whichever comes first.

This may seem like a waste, however the larger waste would be to accidentally use a can of finish that is so old that it does not dry well anymore, which means a completely ruined guitar. The few dollars spent to get a new can of finish are well spent when compared to the time wasted having to completely strip and re-finish a guitar. Save time and money by buying fresh product, and when in doubt dispose of any old finish properly, and buy new.



Storing Finishing Products

A great way to keep finishes as fresh as possible while also elongating their useful life, is to keep them out of the garage. The temperature at some point in the year is going to either be too cold or too hot for the finish, and things will begin to happen to it that make it no longer usable.

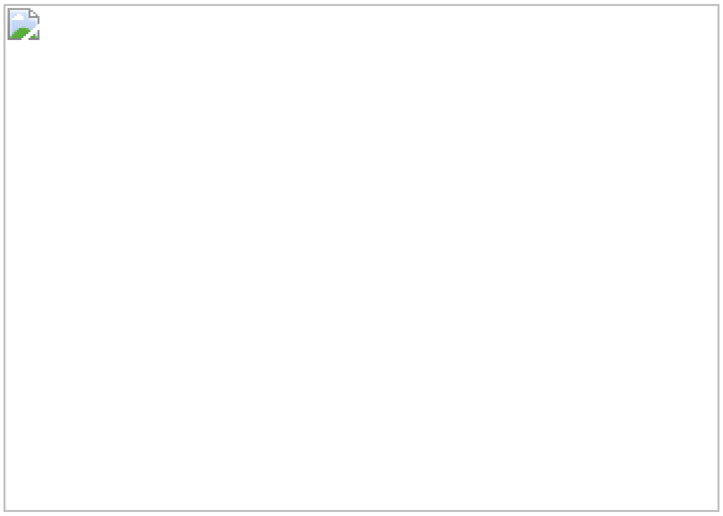
In Arizona, one summer spent in the garage is instant death for any finishing product. The summers regularly reach 115 degrees or more for days, and the nights seldom drop below 100 degrees. Metal cans especially can expand in this heat, allowing finish to penetrate their surfaces and cause rust to form. This mixes with the finish and ruins it. Plastic containers that are half full and have tight fitting lids can pressurize and squirt out finish dangerously when opened. Plus, the heat is typically more than the manufacturer had imagined when the product was made, making the product not function well.

Winter can ruin finishing products by freezing them for an extended period, sometimes making them not adhere properly when applied after the thaw. The ground in a garage will be colder than a shelf, and any container stored on the ground can freeze.

Finishes do best when stored at room temperature, such as in an unused closet or open shelf in a utility room. Storing finishes indoors will make them last longer and work better when applied.

Find an open area where the products can all be neatly arranged and are out of reach of small children and pets. Space the products next to each other, and resist the urge to stack other things on top of them. It is not as though a can if finish could explode at any moment, however they should be treated like any other chemical, and given a safe and ventilated space.

Another good precaution for storing chemicals indoors is to take the time and wipe down the can if some of the finish gets on it during use. A clean set of finish products will cause less problems than a pile of dirty and half open cans being stored together. Plus, there will be no smell of solvents when they are kept clean and orderly.



Using Canning Jars

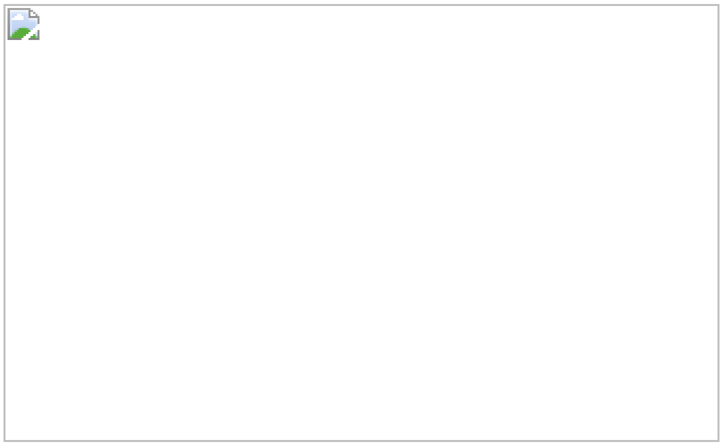
Canning jars are an excellent storage container for perishable finishing items as well as for granulated glues. These come in a variety of sizes to suit the need, and they all have screw on metal lids that are air tight. These jars are used by home gardeners and people who want to store food they have made, and are widely available because of it.

Hot hide glue comes in granules and must be kept dry and away from contaminates in order to be the most effective. Once hide glue granules get wet they have a limited shelf life and become useless very quickly. Storing the hide glue in a glass canning jar makes it very easy to keep it all in one place as well as keep it dry. The glue in the left hand glass jar in the picture above also has a small packet of silica gel, which helps trap and remove any moisture. Hide glue stored in this manner has an almost infinite shelf life as long as the lid is kept tightly in place, and it is in a room temperature environment.

Shellac flakes are another product that will do well in a glass jar, and it will help keep it useful longer than the zipper style plastic bag it normally comes in from the store. Select a large enough jar to hold the flakes, and pour them inside. Close the lid, and there is an air tight seal protecting the flakes from moisture and foreign particles.

Mixed shellac can also be stored in these glass jars, and kept until needed. The lid is a great place to use a permanent marker to write the date the shellac was made, what the cut is, and what type of shellac it is.

This information will come in handy later on when the shellac is used, and will help determine when it needs to be discarded.



Mixing Stains In Jars

Finally, another great use for canning jars is for mixing stains. Dye stains are either concentrated liquids or powders that are mixed with water or denatured alcohol to dilute them. Depending on the concentration of dye, the color will be lighter or darker. Mixing the stains in the glass jar will allow them to be opened and closed many times without any problems, and the jars also make mixing everything as easy as swirling the jar around.

The tops of the jars should be used to record the contents, as well as any other important information about the mixture. Use a permanent marker to write on the lid as much information as possible, including when the mixture was put into the jar, what the contents are, and what the mixing ratio was. This information will be hard to remember otherwise, and it is useful given the fact that almost all dye stains will look the same, and it will be impossible to figure out exactly how many drops were used.

Giving Enough Drying Time

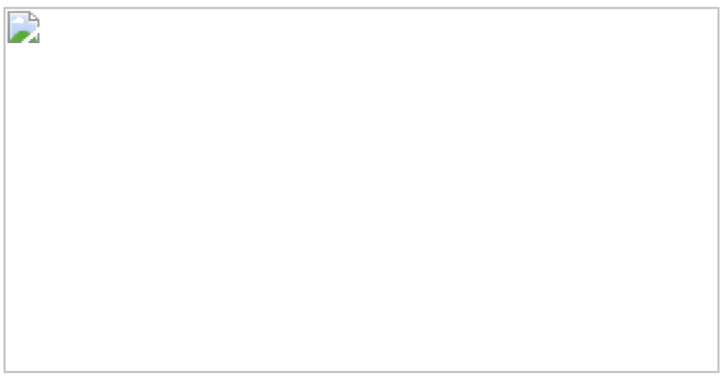
A simple yet often times underused bit of finishing knowledge is to let enough time pass between coats when applying a finish. Finishing takes time, and the urge to speed up the process should be avoided at all costs.

Many new finishers do not fully appreciate the effects of letting one coat dry before applying another one, causing disastrous results. When a coat of finish is applied over a previous coat that is not dry, one of two things happens. The top layer dries over the under layer, leaving wet finish trapped under the surface, or the coats mix together and take what seems like forever to dry. Neither one of these results do anything close to the original idea of applying the coats faster, which was to speed up the process. In fact, the process has been made even slower by adding more finish before the previous coat was ready for it.

If a particular finish says the coats take an hour to dry between applications, they really mean closer to two hours. The finish makers know they are marketing to mostly weekend warriors who care more about the drying time than what the product actually does. This type of person will literally pick one finish over another because it dries faster, regardless of whether the finish is better for their project or not. The manufacturers have responded to this by using interesting methods of calculating drying time. These include timing the drying process in a hot room with almost zero humidity. The effect is the product dries much faster, and they can write a lower number for dry time on the can. This is nothing like the real world

application that will be done in the shop, and some extra drying time has to be given to the finish before another coat is applied.

The moral of the story is to give each coat a little extra time to dry, and the finishing process will go along as planned. Rushing things is one of the biggest causes of problems while finishing, which can be completely avoided by just relaxing and taking some time. The process of finishing a guitar can take several days and then a couple more weeks to cure. Rushing to save a few minutes or hours really does nothing to help the process.



Finishing Temperature

The temperature and humidity in which a finish is applied can have an effect on how long the coat takes to dry. The casual rule is to give more time to a finish in colder and more humid weather, and less in dryer and hotter weather. Also, extremes in weather should be avoided entirely when applying a finish.

In warmer and dryer weather, the solvents in a finish tend to off gas better and more efficiently than in colder and wetter weather. The time given to a finish coat has to be adjusted a little bit to accommodate for this small change. A good rule is the finish should not feel tacky at all, and the fingers should be able to run smoothly over it without getting stuck before applying a second coat.

In warmer weather, allow the full drying time and check the surface. If it looks good, apply the next coat. In colder and wetter weather, give up to twice the full drying time, and still check before applying the next coat. It is possible in very humid conditions that a finish could take several times as long as suggested to completely dry, meaning it is most

likely not a good time to be finishing a guitar. If the process can be brought indoors, the humidity in a central air conditioned home is typically very low, even in very humid places in the world. Bringing the instrument indoors for drying can help decrease the time it takes, and make the coating process go more smoothly.

Extreme weather should be completely avoided during finishing, because it can make it miserable to apply a finish well. Very hot and dry conditions can make finishes dry too fast, causing the applicator rag to get stuck and leave texture marks. It can also encourage pools of finish to dry together, causing them to need to be sanded out. Very cold and humid weather will make the finish take forever to dry enough, and will make anything resembling an efficient coating schedule impossible. If an indoor space cannot be used to finish the instrument, wait until better weather is around to do the process. It will not work well during extreme weather anyway, so do not waste the time.

As long as there is good ventilation, and a way to move around the air in the room, a place inside the house may be the only resort in areas where the weather does not cooperate. Especially with wipe on finishes, the amount of vapor and fumes that will need to be dissipated is relatively low when compared to spraying. Most wipe on finishes are not dangerous at all to apply in the house, and this can be the answer to finishing in a bad part of the season.

Use a room in the house with a ceiling fan and leave the door open. A bathroom with an exhaust fan can also be used, provided the fan is kept on and the door left open. The fan will pull out the fumes and the door will allow fresh air inside. Be sure to always go a little overboard with ventilation, this way a safer finishing environment is always maintained.

A special purpose finishing room can be made from a small room like a bathroom or storage room by upgrading the exhaust fan. This would only work for hand applied finishes because a fan being used in a spraying environment needs to be explosion proof. If the exhaust fan were replaced with a higher capacity model, it would draw out air faster and expel it to the outside.

A room other than a bathroom can sometimes be retro fitted with an exhaust fan, creating a perfect place to use wipe on finishes that is always a constant temperature and humidity.

Use New Rags

When applying a finish with a clean white cotton cloth, it is wise to replace the piece after every coat, just to keep it clean. Sawdust that was not removed well from the surface will get picked up by the cloth as it is used to apply the finish. This can be transferred to other parts of the guitar if the piece of cloth is used again. Also, the finish can dry on the cloth, creating a hard crust that can scratch the surface.

A white cotton t-shirt or a yard of white cotton material to make finishing rags with is very inexpensive. A new rag should be used after each coat so there is no chance of scratching or contaminating the surface with the old and partially dried finish. The old rags must be disposed of carefully, and not piled up in a trash can where they could ignite.

Cut a t-shirt or a piece of store bought white cotton cloth into 5" x 5" squares. Pile the squares up together, keeping them free from dust and other contaminants. These rags need to be as clean as possible to effectively apply finish without adding their own color.

Put as many as will fit into a few plastic sandwich bags, and seal them. These can be stored safely in the shop without worrying about sawdust and other gunk getting on them.

Ventilation

Adequate ventilation is important to have in the area the finish is being applied. This does not mean the room has to be open to the world, allowing all forms of dust and breeze through, but it does mean that some ventilation is needed to waft off the harmful gasses.

As a finish dries, the thinners evaporate into the air, and need to be moved out of the room somehow. An open door and a small fan is perfectly fine to carry out the task, or a ceiling fan on low will work as well too.

Do not under any circumstances shut off a room completely and apply the finish inside. The gasses will build up and it can cause fainting, shortness of breath, dizziness, and even death if the person cannot get out of the room. Always leave an opening to the room being finished in, and always stop working and move into another area of the shop if any of the above symptoms are felt.

Safety Equipment

Along with proper ventilation, wearing adequate breathing protection as well as eye protection is always an important part of finishing.

It sounds like a broken record for a reason, the importance of respiratory and eye protection while woodworking and wood finishing cannot be understated. It is a simple fact that you cannot continue to make guitars or finish them without the ability to see. Likewise, woodworking requires life, and life requires breath, meaning if the lungs become trashed from inhaling solvents, no more work can be done.

Always wear a good set of safety glasses while applying finish. The main purpose is to keep the finish chemicals out of the eyes during an accidental splash. The things in some finishes can blind a person, and all for not taking a simple step and wearing safety glasses.

Wearing a respirator with a filter is a small step to saving the lungs for a lifetime. Solvent chemicals are not stopped by a dust mask, so a respirator is the better choice and they are not terribly expensive. A basic model can be found in most hardware stores, and will do a fine job of keeping the finish out of the body and on the guitar where it belongs. There are more advanced models that come with onboard battery packs and have built in fans which circulate clean air around in a helmet of sorts. These are the premium models, and they come with the matching price tag.

Whatever steps are taken, wearing at least the minimum of safety glasses and a basic respirator can have a huge impact on how long the hobby of woodworking and wood finishing can be enjoyed.

Applying Thinner Coats

How thick the finish is applied will affect how well the process of finishing the guitar goes. Thick coats take longer to dry and can leave marks behind, but thin coats take longer to apply because more of them are needed.

A constant problem in wood finishing is speeding the process up by cutting corners. Using an excessively thick finish is one of those so often cut corners. Applying more finish than necessary to make a nice even coat will not only take forever to dry, but it may shift around before it dries, causing thick spots that will need to be sanded out. Adding more finish than necessary not only makes for a poor quality final look, but telegraphs the woodworkers inexperience to everyone who looks at the guitar.

Instead of applying thick coats of finish, apply very thin coats, and more of them. Several thin coats will look a hundred times better than one thick coat, and will require less sanding to keep it clean looking.

It is very easy to tell when looking at a finish how well it was applied. Corners and hidden places especially will show where finish has been laid on too thick, and these are very difficult to clean out or sand out after the coat dries. Thin coats will always have a close to the wood look, so long as an excessive number of them are not applied, and should be used exclusively when finishing instruments.

Brush vs. Cloth Application

The method of applying the finish is another thing to take a look at when finishing. The two main options for had applied finishes are brushes and rags, however rags are the best choice for several reasons.

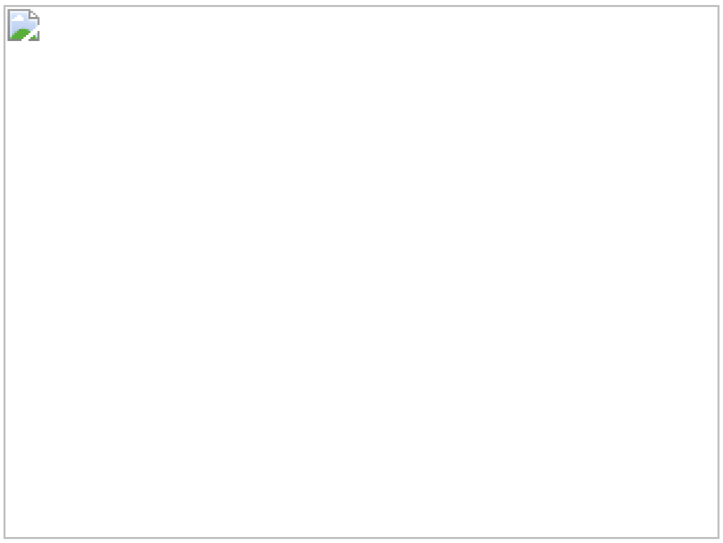
White cotton cloths, the same kind used to make t-shirts from are the best applicators for a hand applied finish. They are super inexpensive, and can be harvested from clean washed under shirts. A yard or two of white cotton fabric can also be purchased from a fabric store and cut into small squares. The expense per square will be next to nothing, and they can be thrown away after they are used. Also, a pack of gun cleaning cloths are really just small squares of cotton rag that are sold packaged together. Spend the extra couple dollars on the nicer ones though, because the super cheap kind will shed small cotton specs everywhere.

When applying a finish, the amount of finish left on the surface will make a big difference in how the finish looks. This is explained earlier in detail, however a cloth will not apply as much finish as a brush, which can be helpful. Brushes tend to lay down a thicker coat of finish than a cloth, because the brush does not soak up the liquid as well. A rag can be used to wipe off any residual finish on the surface while at the same time spreading it out farther.

The rag can be turned over for a cleaner spot to remove more finish, or to a wetter spot to apply more finish. The entire time a super fine

film can be made over the surface that will dry well, and protect the instrument.

Brushes also have the problem of leaving behind marks if the finish is not applied fast enough to cover the entire surface with wet finish. A rag allows the finish to be applied and moved around much faster, which reduces the time it takes to apply it evenly. A lower time of application means a smaller chance of dragging around half dried finish, and causing a rough looking surface because of it.



Sand Between Coats

Sanding or using steel wool between coats is a common practice among finishers to even out the finish between coatings. This has its advantages, however it should only be done when needed. The process of using sandpaper or steel wool removes finish, which is the exact opposite of what finishing is supposed to do. Knowing when to sand and when not to will make a difference in the time spent applying the finish.

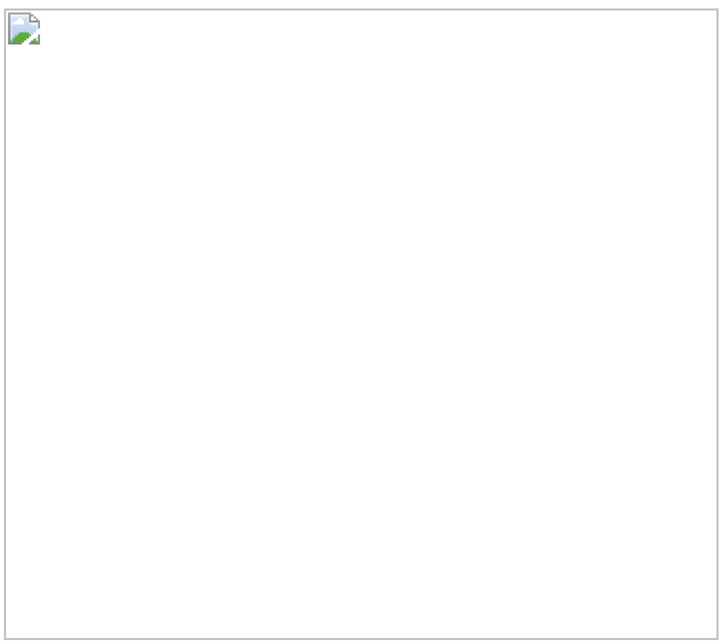
The reason a finish is sanded in between coats is to knock down any roughness and unevenness in the coating. It is a very light passing over with the steel wool or paper, and it is meant to level it all out before adding more finish. That being said, if the surface is already level and not rough, then there is no need to steel wool or sand.

With a hand applied finish, applied very thinly with a piece of cloth, the finish left behind is as thin as it can be. A very thin finish is also

typically a very level and smooth finish, meaning that it will not need to be leveled right away. With the cloth applied finishes, it is a good idea to wait until at least three coats have been applied before sanding anything. The reason for this is a thin coat will be very easy to break through, and if there is no roughness then there is no reason to sand anything.

Steel wool and sandpaper between every third coat, and only if the surface feels rougher than it did earlier in the process. Still, the act is very light to the touch, and only meant to even out the surface before applying the next coat.

The steel wool should be 0000, which is the finest available, and the sandpaper should be at least 800 grit or higher if it will be used instead. Try the steel wool first, though it will take a little longer to remove the material, the chances of going through the finish are far less. A few extra seconds of using the steel wool are worth it for a good finish.



Making a Test Board

Making a test board is covered in depth earlier in the chapter, however it is worth mentioning here as a great finishing tip. A test piece is a very inexpensive piece of wood that is the same species as the guitar to be finished. Better if it is the same color as the guitar, and better still if it was a cutoff of the exact same piece of wood. The test piece gets coated in finish

to decide if it looks good or not. If it does, the guitar is finished with the same process, if not, the scrap is tossed in the trash and a new method is worked out.

Having the ability to see how a finish will look before actually committing to it is very valuable. Since guitars are expensive to be throwing out if finished poorly, a test board is the perfect answer. Test out all finishing products or ideas on these pieces, and decide which among them is the best looking and best performing for the guitar. Dozens of scraps can be gone through if necessary without very much cost, since most of these pieces were destined for the scrap bin or trash can anyway.

Layering Finishes

If a multi-layered finish is being used, such as in the above diagram, a test board is also great to use because it will show how they will all look together, and more importantly if they will be compatible at all when layered. If an oil is used to enhance the grain as the first layer, and let dry completely, shellac can be applied over it. This will add an amber effect, giving the wood a traditional glow. Once it has dried, a layer of wiping varnish can be applied to give the finish some toughness and resistance to abrasion. The best way to see how this would all look together is to gather all the finishing product needed, and make a test board with all the layers.

Once the test board is completed, it can be examined to see if the effect of each product shows through in the final look. Perhaps more shellac is needed to further amber the finish, or even a darker variety of shellac. Maybe the top coat is too glossy, and would be better as a satin or semi-gloss. All of these things can be addressed when a test board is made, which is much easier than spending two weeks finishing a guitar, and then having to re-finish it.

When a problem is detected in the finish of the test board, make the recipe changes and make another test board. Do not just assume that

more of a certain product will be the answer, the second test board will have the same probability of coming out not looking right. Make test boards modifying the recipe until the right look is found.

Layering finishes is something that takes time end experience to learn. Most finishes will work fine over and under one another, however there are some that will absolutely not work at all. Also, some finishes contain things that are not meant to be mixed with other chemicals, so doing some research before experimenting is well worth the time.

As a general rule that applies in most situations, any finish can be applied over any other one as long as the first layer is completely and thoroughly cured. With the finish completely dry, there is not as much worry about thinning chemicals mixing, and not allowing the new layer to dry. When in doubt about whether a finish has cured completely or not, give it a cautious smell. If any solvent can be detected, it has not fully cured yet. Most finishes reach a total cure after a few weeks, though some will be done faster.

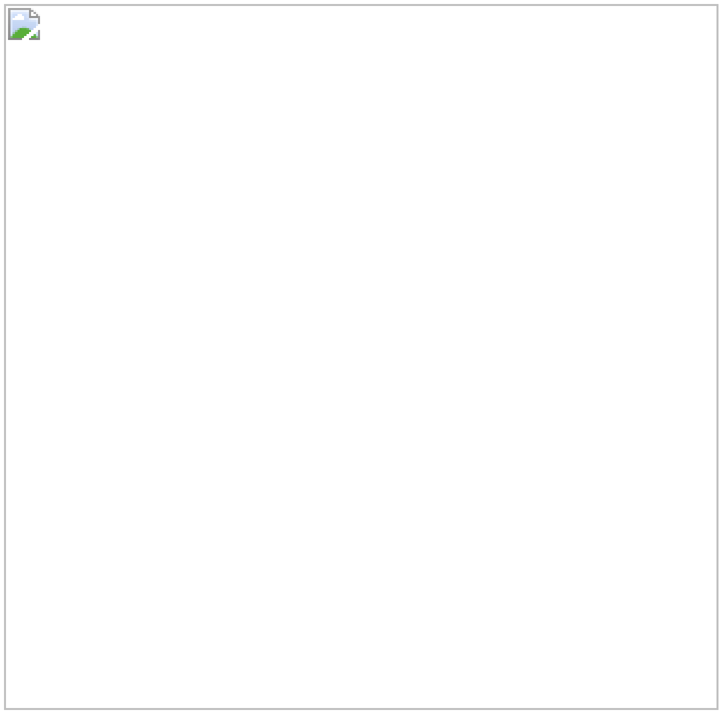
If layering finishes, make sure there is something to gain from doing so. Using Tru-Oil, then Danish Oil, then Boiled Linseed Oil in three layers will do nothing more than if any one of them was applied in three coats. There needs to be a reason to layer different products, more than just for the sake of doing so. In the example in the previous column, each layer of finish gives something to the final look, if it did not, the layer would be skipped or replaced in favor of something else.

Mixing Finish in the Can

The contents of some finishes can settle while they are in storage or when sitting on the store shelves waiting to be purchased. The contents needs to be mixed, however shaking them is not the way to do it.

Shaking finish introduces microscopic air bubbles into the solution, which can be hard to get out as the finish is applied. Trying to pop out or remove the bubbles will take forever, and may affect the final look of the finish. This is more prevalent when using a brush to apply the finish, since a cloth will not allow any bubbles to remain after the finish is wiped on the surface.

Instead of shaking the can or bottle, swirl the contents using the wrist, as if trying to create a tiny tornado inside the can. This will get all the contents into solution and mix them well. Swirl the can gently for 30-60 seconds, and then remove the top and the finish should be fine to work with.



Using Good Products

The difference in price between a high end finishing product and the entry level knock off is normally only a few dollars. Buying cheap finish for a handmade guitar is like buying grocery store tires for a sports car. It makes no sense what so ever.

Once a type of finish has been selected, it becomes the responsibility of the finisher to find the best available product. Look online and ask other woodworkers or luthiers to share their experience with that type of finish, and what product they would recommend. It is hard to find a woodworker who does not want to talk at length about what they do, so asking someone is really a good habit.

When a product is finally selected, make sure it is on the merits of the finish and not at all on the price. There are only a few hand applied finishes that would be used on a guitar, and none of them are expensive for the name brand. Buying a cheap product to save a dollar or two is really short changing the guitar in the end.

A guitar is meant to last decades, so using a good finishing product with a trusted track record regardless of price, is always a good way to go.

Do Not Thin or Mix Finishes

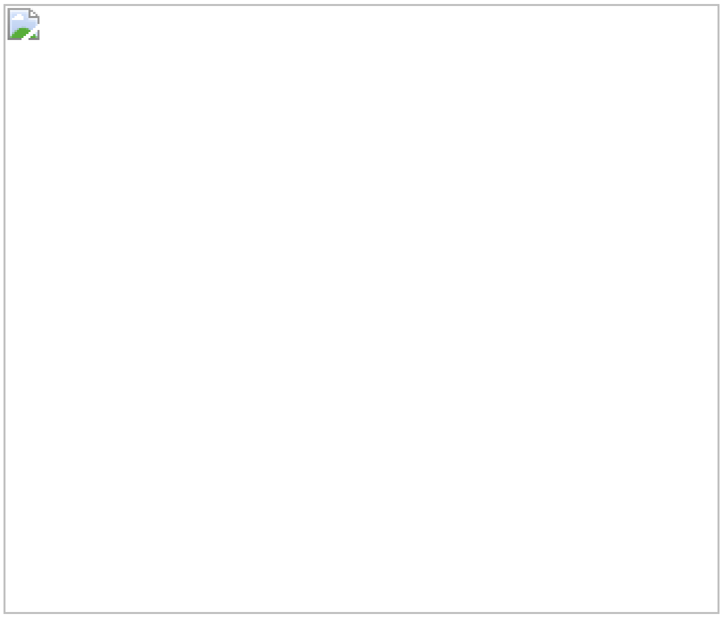
The manufacturers of finishes have been doing just that for decades or more, and they really do know what they are doing. They have large test facilities where their formulas are tested, reformulated, and tested again. Literally thousands upon thousands of man hours go into the research and the testing of their products before they ever get on the hardware store shelves. There is no reason to alter the existing formula of a finish, because it was designed to work the best just the way it is.

The mixing of finishing products is a dangerous practice for those who do not have the experience needed to understand what they are mixing together. Finishes contain many chemicals that can react poorly when mixed together, causing toxic vapors and potentially getting the user very hurt. The only reason to mix a custom finish or alter a finish is if it is a well known practice with a long track record, which is usually not the case.

If finishes are going to be layered over one another, it is completely different than mixing, because the chemical elements have mostly dissipated once the layer has dried. Mixing wet ingredients to get a certain look however is never recommended.

Trust the formulation of finishes that come from manufacturers because they have literally millions of dollars wrapped up in testing those products out before selling them. The manufacturers what the finishes to

work well and last a long time, because they want people to continue to use their products. Buy a solid and well known finish from a trusted maker, and do not thin it, mix it with anything else, or alter it in any way. It is great just the way it is, and will work the best exactly the way it is mixed.



Dye Walnut To Look Like Rosewood

Walnut can be made to look like Rosewood if it is stained with an aniline dye stain. It should never be used to pass off Walnut as Rosewood, but it can be used to give a piece of Walnut a dark look that retains the figure.

Aniline dye stains are a great way to use stain without obscuring the grain of a nicely figured piece of wood. Regular stains have pigment particles that lay on the surface like paint does, and in fact several layers of stain would have the same grain hiding effect as regular paint. Dyes actually change the color of the wood fibers through a different process, not depositing anything that would prevent seeing the grain on the surface.

Mix a medium strength dark brown dye stain using denatured alcohol. Dip a rag into the dye and wipe it all over the Walnut fretboard. The dye will dry very fast because the alcohol will evaporate better than water. Look at the coloring, and apply a second coat if desired. Usually a couple to a few coats leave a nice dark surface, but not so dark the variations in the wood cannot be seen.

Allow the fretboard to dry for a couple hours before adding a light coat of either shellac, Tru-Oil, or wiping varnish to the surface. This will trap the dye under a protective layer, and prevent it from coming off on the hands while being played. Once this light layer of finish dries, add two more thin coats to make sure the dye is well trapped.

This technique is best reserved for fretboards and peg head veneers, though it can be done on a walnut body. The body of the guitar is hard to work with around the bindings and lighter colored woods, because stain will want to seep into those places as well. If the body will be stained, use a little shellac or sanding sealer and carefully coat the bindings and any other wood that will not be getting any stain. This will help prevent the stain from getting into those areas, however it is not 100%

For a little added protection, if the body is to be dyed make sure to add a line of purfling on the bottom of the binding strips. This will normally be black/white/black purfling, which if the dye seeps into the first layer will not be seen.

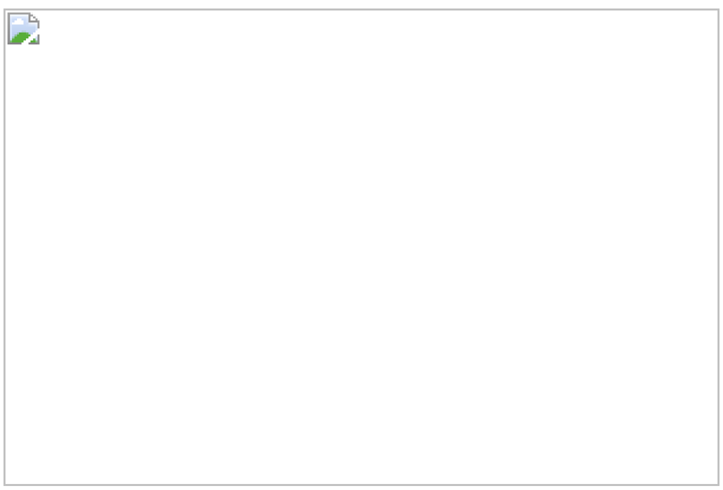
Finishing Safety

When looking at finishes, there is a common belief that they are all poisonous to people and pets, and need special treatment. While it is true that finishing products in liquid form are very poisonous if ingested, the opposite is true for any finish once it has completely cured. In fact, just

about every single finish is completely safe to eat off of once the finish has totally cured.

There should be no fear or change in finishing products because a guitar may be given to a young child. The finishing industry has latched on to the fact that people believe there are some finishes that are safer than others, and are willing to pay more for these finishes. The simple fact is that the harmful things in a finish are designed to evaporate out of the finish while it dries and cures. If a MSDS or Material Safety Data Sheet is reviewed on any finish being used, typically all the dangerous ingredients are listed as those that will be expelled during the curing phase.

Do not change finishing habits based on who will be getting the guitar. There is no reason to worry about a finish causing a problem for someone, as long as it is fully cured before giving the guitar away. If this is still a concern, make sure to give the guitar an extra couple weeks beyond the normal cure time, to ensure it has completely finished curing. Once no chemical smell can be detected with the nose, the curing has completed.



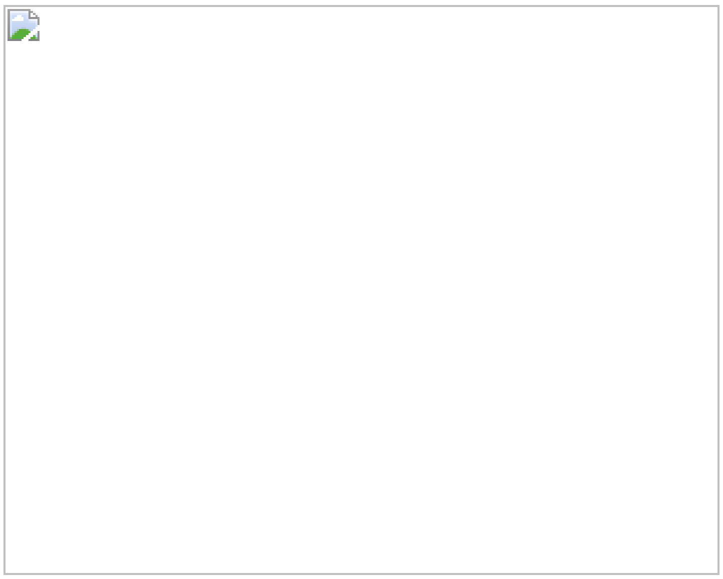
Rag Disposal

When finishing chemicals are left on a cloth rag, they will evaporate and make warmth. If they are stored together in a trash can where the heat cannot dissipate, a fire can start. Since finishing chemicals are normally very flammable anyway, adding a heat source near them is a recipe for disaster.

The best way to neutralize this problem is to wash out old rags thoroughly, and dry them before throwing them away.

In a utility sink, run water through a finishing rag for a few minutes. Squeeze the rag out several times while under the running water to help remove as much of the finish as possible. After the rag has been thoroughly washed, drape it over the sink faucet.

In a few hours or overnight the rag will dry in a very open area where the heat and the chemical (assuming any is left after the washing) can dissipate safely. Once the rag is completely dry, it can be thrown away without worry.



Keep A Finish From Skinning

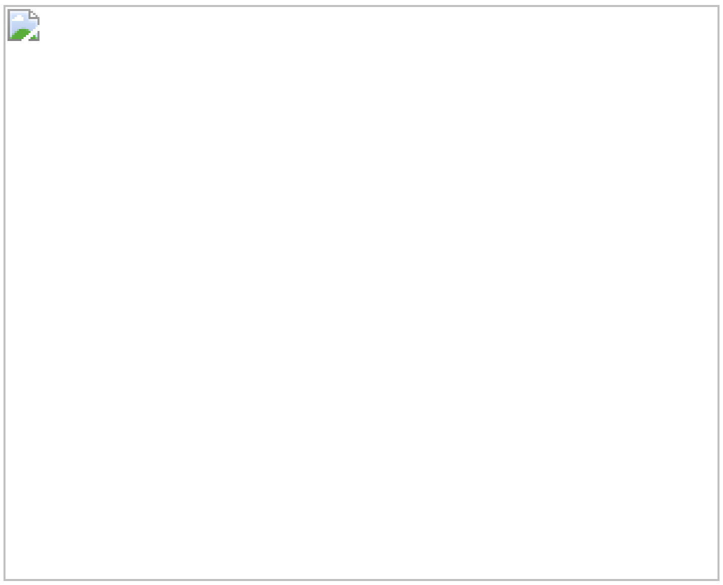
Some finishes react with oxygen when they cure, which is how they dry on the wood. They can also sometimes do this in the can when most of the product has been used and a large amount of air is left inside. The finish that is closest to the top reacts with the air inside the can and begins the curing process.

Sometimes a can of finish that has not been used in a while is opened and there is a skin over the top of the product. If this is the case, simply remove the skin while wearing gloves, and as long as the finish underneath is not lumpy or thick, it can be used. If the finish has started to solidify under the skin, dispose of the can properly and buy a new one.

There is a product made called Bloxygen that is an inert gas for dispensing into the can before it is sealed. It displaces the oxygen in the can, replacing it with a gas that will not allow the finish to cure or skin over.

One can will last a long time, and does not cost very much when compared to how much finish it may save.

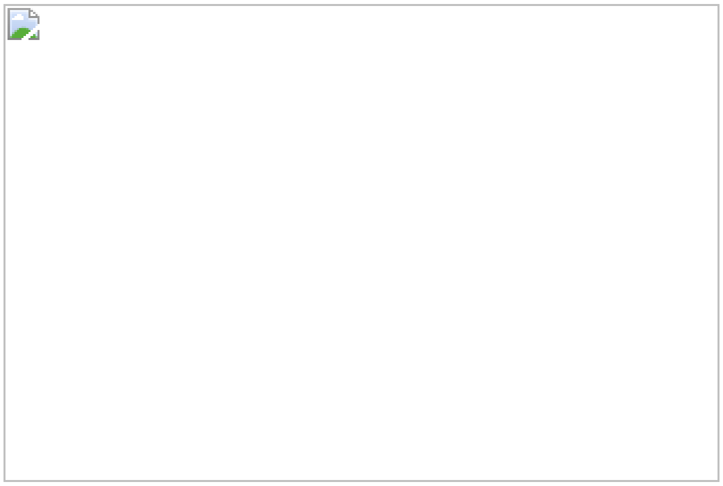
Some people add marbles or glass stones to the finish can in order to raise the liquid level and keep most of the air out of the can. This would work, however once the can is mostly marbles and rocks, it will be hard to get the remaining finish out, meaning it will be wasted. This method will end up wasting the last quarter of the can every time, which will end up costing more than the Bloxygen in the long run.



Wear Gloves

Especially when working with dye stains, it is very important to wear gloves while finishing. The idea of walking around for three days with red mahogany fingers does not sound appealing to most, and a dye stain can take that many days or more to come off, depending on how long the contact was.

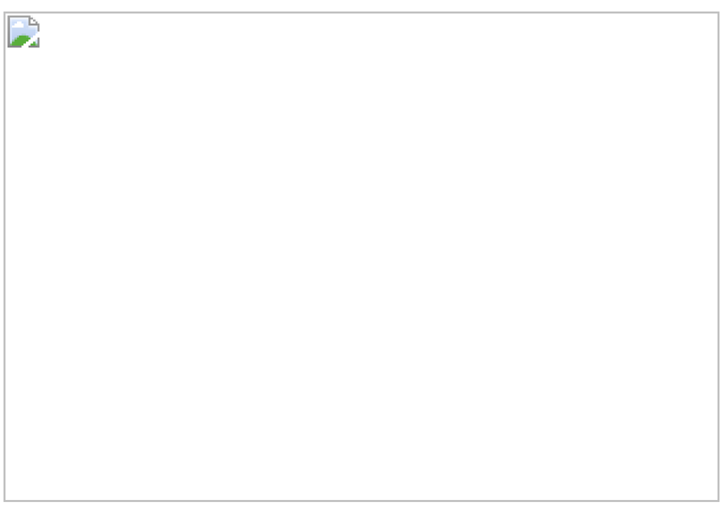
A small box of latex or nitrile gloves is only a few dollars, and they are disposable. Use a pair each time finish is applied or mixed, and they will keep the fingers safe and color free.



Finish In The Morning

If there is not a separate place in the shop to finish wood away from dust, the next best thing to do is start finishing first thing in the morning, when all the dust in the shop has had time to settle. As long as the shop is an enclosed space, all the dust in the air should have had time to settle to the floor if left undisturbed overnight. This includes open windows, cracked doors, and even central air vents.

Carefully walk in the shop, trying not to kick up any dust, and begin finishing the instrument. It is also a good idea to leave all the finishing supplies in the shop (as long as it is not freezing or very hot), but keep the guitar indoors so dust does not settle on it overnight.



Artist Oil Colors

Artists colors that are suspended in linseed oil, such as Winton Oil Colors can be used to tint an oil finish. These tubes are sold in art supply stores or online, and are essentially ground pigment in a very bold color. They can be mixed with Tru-Oil or boiled linseed oil and a colored finish can be applied to the guitar.

Normally, acoustic guitars are not colored at all. Staining is rare, and finishes are normally left in the original color they come in. This produces either completely clear, or slightly amber toned top coats. A small amount of artist pigment however is a great way to add color without going all the way to painting or staining.

It is best to seal the wood with either a couple coats of the same finish, or a sanding sealer prior to beginning the coloring process. This way the color can be moved around the surface better than if it were allowed to soak directly into the wood. A mistake over a finish coat can be wiped off, where a mistake on bare wood will need to be sanded out.

Add a very small amount of artist oils to an ounce or two of an oil finish. Blend them well so there are not any large chunks left in the mixture, and test the coloring out on a scrap piece of wood. A little coloring goes a long way, and if too much is added it will be a very bold color application.

Once the coloring looks fine, it can be applied to the guitar in the same manner. A great look for a guitar is a slight reddening of the instrument, much like a violin. After a couple clear coats, apply a couple oil coats with a small amount of a deep red oil pigment mixed in. They will add a very faint red hue that can be further accented by a couple coats of amber shellac, to add a little more warmth and tone to the look.

Practice, Practice, Practice

The best piece of advice that can be given to a person new at finishing is to make as many test boards as possible, and try out a wide variety of finishes. The only difference between an experienced finisher and a new finisher is the amount of time they have spent working on their craft. A beginner can speed through the awkward beginning phase very quickly by simply sticking to a few simple finishes, and focusing on applying them well.

A simple Tru-Oil finish is one of the best looking in all of woodworking. The same goes for a wiping varnish. Learn them well, and finishing will become much easier.

APPENDIX I

USEFUL WEBSITES

WWW.PIXLR.COM

Pixlr is a free source for editing and creating pictures on the computer. This cloud based program has editing features similar to the expensive programs, and has all the features needed for a guitar maker. There are a couple versions of the program on the site, though it is the advanced one that has all the features that are needed. A photo editing program makes it easy to create custom soundhole labels for acoustic guitars, custom business cards, custom t-shirt graphics, and many other projects.

WWW.STEWMAC.COM

Though I go on at length in this book about making things in the shop, sometimes that is not an option. Stewart McDonald has a ton of guitar building products, and literally a tool for every conceivable task in guitar making. They are the source for several of my metal and bone items, as well as most of my acoustic guitar tops. They have a catalog that makes excellent bathroom reading, and will ship one for visiting their website.

WWW.LMII.COM

Luthiers Mercantile International Inc. is a fantastic source for all things guitar related. They have tools, books, and an extensive selection of acoustic guitar tone wood. Though they are primarily a wood source for me, they do have many useful items on their site as well as in their free catalog. If very exotic and interesting wood is part of the building process, then LMII is an excellent and reputable online source.

WWW.WOODCRAFT.COM

Woodcraft is an in-store and online retailer of fine woodworking tools and accessories. They do not sell concrete, flowers, lawn mowers, or plumbers tape like the big home improvement stores do. All they sell are high end woodworking machines, precision measuring devices, and hand tools of exceptional quality. The hard to find tools that cannot be found elsewhere can be found in a Woodcraft store, and the knowledge and experience of the staff is well worth the trip.

WWW.GRIZZLY.COM

Grizzly Industrial Inc. is a mammoth tool company that sells mainly online. They deal in the smallest of tools, all the way to tools that require shipping in a semi-truck to deliver. Their prices are unbeatable, and their quality is better than the prices would suggest. They also have a small section of guitar making items, and a really good deal can be found there. On certain items they are very economical, and I have used several pieces of theirs in my shop with success.

WWW.JHLOWE.COM

This is my favorite online source for Briar wood, which can be used for many guitar related projects. They have been in business forever, offer a wide array of sizes and types of Briar, and have the best pricing I have found. It is best to call them to place an order, because they do not have a method of taking payments online. Briar can be used for bridges, end flash, peg head veneer, sound hole rosettes, and custom pick guards. It is a beautiful burl wood that takes a finish with a depth and beauty that has to be seen to be believed. It is unfortunate that it does not grow large enough to make a fretboard out of.

WWW.PIPEMAKERS.ORG

Pipe Makers Emporium is a great source for higher end Briar wood that has an amazing look and a higher price than the cheap stuff. They sell absolutely amazing pieces of plateaux Briar that requires book matching to make a bridge blank from, but is a stunning piece to see. They also sell buffing wheels for the Beall buffing system, which is a very easy way to polish wood to a glass smooth finish. The alcohol based stains required to do some of the staining techniques in the book are also sold

there. They take orders over the phone, and they have a really nice selection online.

WWW.YOUTUBE.COM

Everyone who has a passion and a hobby and owns a computer should be best friends with the YouTube website. There are at least a dozen videos on absolutely every subject known to the human race on that site, and they are all free. Many people (including myself) publish some free information about their hobby. I have several guitar making videos under the name Six Gun Guitars, take a look.

GLOSSARY OF TERMS

The following is a glossary covering the vast majority of guitar making and woodworking terminology, that may be unfamiliar to the beginner. With guitar making, there is a certain amount of vocabulary that must be known in order to be able to follow and understand directions and explanations. This list will be helpful in gaining a better understanding of woodworking as well as guitar making.

-1,2,3-

3 and 3 Tuners

Tuners that are meant to be used on a symmetrical headstock design, where three of them go on one side and the other three go on the other side. They are slightly different from each other, depending on which side they go on, so that the tuning knobs and shafts are in symmetrical positions when viewed from the front. These are going to be the most common tuning machines used on acoustic guitars.

4/4

The term 4/4, also called four quarter, is used when talking about wood that is sized in a standard saw mill dimension. These pieces will all be about 13/16" thick, plus or minus 1/16". It is easier to refer to wood as 4/4 than it is to call it 13/16", so this is used frequently in the book. Also, lumber in a hardwood store will be priced differently depending on the thickness, so knowing the difference on sight between a 4/4 board and a 8/4 board is important.

6/4

These boards will be about 1-5/16" thick, and are not as common as 4/4 or 8/4. See 4/4 for more information.

8/4

These boards are 1-3/4" thick, and are used for getting more blanks from a single board than 4/4. See 4/4 for more information.

12 String

A guitar with twelve strings is called a twelve string guitar, and each course is double strung with a standard string, and another that is one octave higher. They are played together, which gives a fuller and richer sound than when playing a single string.

-A-

A-Style Braces

A variation of the standard x-bracing pattern, this is where the soundhole braces do not stop at the top horizontal brace, but extend through that brace and terminate at the head block or next to it. This requires two small holes in the upper horizontal brace, as well as a more square soundhole brace profile.

Abalone

An inlay material cut from the shells of sea snails, exhibiting a swirly pattern of greens, blues, and silvers, with iridescent properties. A favorite among guitar makers, abalone can be used as a decorative inlay around the soundhole, as purfling, as fretboard markers, and as headstock inlays. The shells are cut into blanks and inlay pieces in factories, and sold to guitar supply houses who re-sell it to guitar makers.

Ablam

When several pieces of natural shell Abalone are laminated together into a large sheet, this is called Ablam. The smaller pieces are matched for color and glued together to form a larger sheet where more and larger inlay pieces can be cut from. This is still technically a natural product, though the glue lines and connection points can be seen if examined carefully and closely. Abalone itself only grows so big, so having a laminated piece may be the only way to have enough surface to cut a larger inlay.

Abrasive

A term relating to sandpaper typically, where the item is used to remove material from the surface of another item. Abrasive paper is used to remove scratches from wood. There are other items that would be considered abrasive to wood, however the term is mainly used to describe sandpaper of some type. Also see Sandpaper.

Abrasive Cord

A piece of thin string that is impregnated with sanding grit, and can be used on a nut or saddle to make small nicks or clear string slots. It is used much the same way that dental floss would be, and can be used on metal as well. On older bridges, the metal blades that the strings rest against are sometimes rough, and the cord can be used to remove those scratchy areas and let the strings lay better. This can also be used on a metal locking nut for the same reason.

Accelerator

Used with CA (Cyanoacrylate) glue, this pump or aerosol spray causes the CA glue to dry almost instantly. The glue is applied like normal, and the pieces are held together. A quick shot of the accelerator on the joint and the bond is formed immediately. It is a great way of getting multiple gluing steps done very quickly when inlaying, because the glue will never slow the process down. Sold in the same area as the CA glue, purchase the same brand as the glue to be on the safe side.

Action

Refers to the height of the strings over the fretboard. Typically this term is expressed in three ways, low action, medium action, and high action, and is measured over the 12th fret. The definition of a high or low action is normally determined by the player, because different players are used to different setups. However, there are some loose standards for what would be considered low, medium or high.

Adhesion

A descriptive term having to do with how well something adheres to something else. A product that adheres well is said to have good adhesion, and one that does not will have poor adhesion. Adhesives cause adhesion, and finishes can adhere to wood.

Adhesive

Any compound that will bond two or more items together can be considered an adhesive. There are many examples of adhesives, the most common in the shop will be wood glue, epoxy, and super glue. Selecting the right adhesive is very important in making sure that the bond will be strong and last a long time.

Air Dried

Wood is often referred to as air dried, meaning that it has been dried in a slower and more natural way than using a large kiln, which uses heat to dry the wood.

Aliphatic Resin (AR)

Aliphatic resin is the AR in AR glue. This is the common yellow wood glue that is a staple in woodworking and guitar making shops. It is similar to PVA glue, however the bond is stronger, and it has better performance when gluing wood. An example of Aliphatic Resin glue is Titebond Original.

All Thread

The name for the long threaded rods that are found in hardware stores, and used to make spool clamps and other fixtures. Also referred to as threaded rod, these can be as long as several feet and come in many different thicknesses. Relatively inexpensive, one piece of all thread can make several spool clamps or a few Lapstrake clamps.

Allen Key

A "L" shaped tool that has a hexagonal profile on either side, and is typically used to turn machine screws. Also called a Hex Wrench, or Hex Key. The long side can be turned for more torque on the screw, or the short side can be turned when less pressure is desired, preventing damage to the screw or surrounding material.

Aluminum Oxide

The grit on sandpaper is made from several different materials, one of which being aluminum oxide. The advantage to using aluminum oxide for sandpaper is that it is harder and tougher than many of the materials that the sandpaper will need to abrade. When sanding through harder woods and shell inlay pieces, having a stronger and harder grit on the paper will make the job go much better. If the piece being sanded is harder than the grit on the sandpaper, it will not be affected by the sanding action.

Amplifier

A piece of electronic equipment that takes a weak signal from an electrified instrument, and makes it louder for performing. These can have several channels and many adjustments including volume, gain, and an equalizer. The sound is made audible through a single speaker or several, and they are made by many different companies.

Angle Finder

A small measuring tool with a metal plate and a swing arm that is used to figure out angles. It can come in many different styles, some with gauges and digital readouts, but they all make it possible to accurately draw an angle or find the measurement of an already existing angle. A simple manual angle finder that is easy to read is perfect for guitar making, and is used to set the neck angle as well as the headstock angle.

Angle Gauge

Often a digital item, the angle gauge is used to measure the blade angle on a table saw to ensure it is accurate. Most saws have only a basic adjustment, which can be off by a fraction of a degree, making angled cuts a little off of where they should be. An angle gauge is calibrated on the table top, then placed on the blade where a magnet keeps it in place. The blade is then set to the correct angle and locked into place.

Animal Glue

Animal glue is made from the tissues of certain animals, but the term is most often used when talking about hide glue. See Hide Glue for more information.

Arbor

A piece of steel that holds a blade to a shaft such as in a table saw, or a connection for something else to a rotating shaft. It serves to hold the cutter or buffing wheel in place while rotating, and keeps the item in position while in use. The buffing wheel arbor keeps the wheels from flying off during rotation, and the table saw arbor keeps the blade straight and prevents it from wobbling. Arbors come in many sizes and they are made to suit the shaft and the item they are designed to hold.

Arbor Press

Simply a metal base with a long arm, that when pulled causes a ram to come downwards. This piece can be used with a caul to seat frets cleanly and easily. A small arbor press is all that would be needed for fretting, since even the small presses can exert a lot of pressure. Any time that something needs to be fitted with pressure, the arbor press is a good candidate.

Arch Top

A type of guitar that has a carved top, similar to that of a violin or cello. Normally, acoustic guitar tops are flat or slightly domed depending on the bracing and style. Arch top guitars have so much of a dome that they need to be carved from larger and thicker pieces of wood. The bridges on arch top guitars are moveable, and they use a tailpiece to hold the ball ends of the strings. This creates downward pressure on the bridge, driving the soundboard.

Artists Oils

Most oil paints that can be found in tubes at an art supply store are simply pigment that has been mixed with linseed oil. The linseed oil is what keeps the pigment particles together and allows them to be spread on the canvas. These pigments can be mixed with boiled linseed oil or Tru-Oil and used to color and shade a piece of wood. Incredibly rich and deep colors are available from artists supply stores, and they turn a guitar top into something even more beautiful than it was alone. Bright powerful colors like Cadmium Red Deep Hue, and French Ultramarine, or Chrome Green Hue and Prussian Blue will make a guitar top stand out from across the room. They can be used any time a colored top is desired without having to resort to using paint. Yes, pigment is paint, however these products when mixed with oil still allow the texture and depth of the wood to shine through, which is very unique and eye catching.

Awl

A long pointed metal tool that looks like a spike with a handle. It is used to score lines on wood, and to mark centers for drill bits to follow more easily. A good awl can be helpful to scratch out inlay outlines for routing, and for making dimples that allow small screws to start easier.

-B-

Back Saw

A small handsaw that has a long metal stiffener on the spine, which keeps the blade from bending while being used. A back saw can be used to cut the scarf joint for the neck, or to hand cut the notches in kerfing strips. They come in several sizes and tooth sets, and are a useful item around the shop.

Back Stripe

An inlay of a decorative strip or a simple binding strip that covers the center seam on the back of an acoustic guitar is the back stripe. This has a visual as well as a structural component, adding to the look of the guitar as well as making the long thin seam stronger. Back stripes can be elaborate wood mosaics that are specially purchased, or they can be a single piece of contrasting wood. Normally the back stripe will fit into the look and style of the binding strips, and match well with them.

Ball End

The end of the guitar string that has a small metal hoop tied to the wire is called the ball end. This end is pushed through the bridge pin hole, and becomes stuck under the top when the bridge pin is put in place. The large ball cannot pass through, and gets stuck under the soundboard, locking the string in place.

Ball End Hex Key

An allen or hex wrench with a ball end on the longer of the two arms, which allows the tool to be inserted into the screw head at a little bit of an angle, and still turn it properly. These are great to have if a regular allen key cannot get to the bolt due to something being in the way. If buying allen keys for the first time, skip the hassle and buy a ball end set. They are only a little more expensive, and can do everything the regular type can plus more.

Band Clamp

A clamp that uses a long strap or band that is ran through a ratchet system that tightens it around a work piece is a band clamp. Band clamps are useful for oddly shaped pieces, or for large pieces that other clamps cannot get to. Band clamps normally have a ratchet system to tighten them, however a long band can also be wrapped around a piece several times and tied, which will achieve the same effect.

Band Saw

A band saw is a shop tool that uses a long circular band of metal with teeth on one side to cut wood. There are two large wheels that the band is wrapped around, and they are driven by a motor. The teeth move in one direction, continually cutting wood as it is fed to the blade. These come in small table top models that are surprisingly good for guitar making, as well as large floor standing models that have the capability of re-sawing large pieces of wood. A band saw has many uses in the shop, and can be fitted with different blades and even abrasive belts.

Bar Clamp

A style of clamp that uses a metal bar to hold both clamping arms in place. One side is moveable while the other is fixed, and they can apply very heavy clamping pressure. The moveable side sometimes has a trigger that advances the clamp, and they all have a release mechanism somewhere on them that disengages the clamp when they need to be removed. These are easier and faster to use than screw style clamps, because they can apply and remove pressure so quickly.

Bark

The outermost layer of the tree that is rough and usually dark in appearance. It is used to protect the tree from insects as well as weather and rot. Some species of tree have very thin bark, and others very thick bark. All bark should be removed from any wood before using it in the shop.

Bass Side

When viewed vertically, the half of the instrument that has the lower strings is called the bass side. This would be E, A, and D on the acoustic guitar in standard tuning. The reason bass side and treble side are

used is because left and right wound be different depending on whether it was a left or right handed instrument.

Bear Claw Figure

When some pieces of Spruce are split open, they may have a wavy, side to side pattern of what look like fine swirls. These are referred to as bear claw figure, and are often very interesting and beautiful looking.

Bearing

Used in woodworking to guide router bits, the bearing allows the bit to be ridden along the wood without burning. A bearing is a circular disc that rotates without friction, and they come in a variety of sizes. A rabbeting router bit set will come with one bit, and several different diameter bearings, which vary the depth of cut. Bearings are also on flush trim router bits, and are the same diameter as the cutter head.

Belly

Often used as a term for classical instruments, it refers to the top of the instrument where the bridge is located, and where the majority of the vibration occurs. The belly of the guitar would be the lower bout area of the soundboard where the bridge is, and the surrounding area.

Belly Braces

Refers to the bracing that is on the soundboard, in particular near the bridge and center of the plate. These braces influence the sound of the instrument depending on they are placed and how thick they are.

Belt Sander

A type of power tool that rotates an abrasive belt that is usually a few inches wide, at a speed where it removes material from wood very rapidly. The belt sander can come in many sizes from small hobby models to large floor standing models. Belts vary in size from one inch to several inches, and come in several standard grits.

Bench Top Tools

Special tool sizes that are made for the woodworker with limited space, and can fit on the bench are called bench top tools. These are smaller

than their floor size counterparts, however they usually have fairly similar features. For guitar makers, large floor standing tools are not needed, and most bench top sized tools are big enough to handle the job.

Bending Blanket

A super thin electric blanket that heats up and is used to bend wood. See Heating Blanket for more information.

Bending Iron

A bending iron is used to heat bend the sides of the acoustic guitar. It is heated either by electric or using a torch, and the heat causes the wet wood to steam, which makes the fibers pliable. This allows the piece to be bent without breaking, which would happen if there was no heat applied. Normally the iron consists of a cylindrical or tear shaped piece of metal which gets hot, and an apparatus to hold any electrical components. They can be purchased online, or they can be made very easily in the shop.

Bending Pipe

Similar to the bending iron, this is simply a piece of thick walled metal pipe around 2" in diameter with a blow torch for the heat source. It can be clamped into a vise for stability, and works in a similar fashion as the Bending Iron. See Bending Iron for additional information.

Bending Strap

A thin piece of sheet metal that is around 6" wide and can be 12" to 24" long. These are used as a support for the exposed side of a piece of wood, while it is being bent. The metal strap keeps the wood from splitting as easily, and traps steam in the wood, making the bending process easier. Straps can be bought or handmade, and they will make the bending process go much more smoothly than without.

Bevel

When a piece of wood is cut at a 45 degree angle relative to the edge or end of the board rather than the top like a miter cut. A bevel can be made with a compound miter saw, a hand plane, or a router with a chamfer bit. Bevels are typically straight, and not rounded over.

Billet

A term given to a piece of wood of a particular size and shape, meant to be used for guitar making. A billet of spruce can be cut down to make soundboards, and a billet of Maple can be split to make a back or electric guitar drop top. The piece does not necessarily have to show any particular quality or size to be called a billet. They usually refer to shorter and thicker pieces as billets, however any raw piece of wood that needs final cutting and shaping can be called a billet.

Binding

Binding is used to describe any piece of long thin material (usually wood or plastic) that is used to conceal the joint between the plates and the sides. It adds strength to this area, as well as offers an opportunity for the guitar maker to show off their woodworking and artistic skills. Binding is often used to embellish the guitar, using fine and exotic woods with amazing figure and flash. Well chosen binding strips can completely change an acoustic guitar, and showcase the skill of the builder.

Binding Tape

This is a type of paper tape that is specially made for guitar makers. It has a little less tack than regular tapes, which helps avoid tearing out grain when removing it, and it is used to hold binding in place while the glue dries. This is a fine product, however a roll of blue painters tape will work just as well. The binding tape will be a little stronger, however the binding strips should be bent correctly before installing them. Well bent strips will not need ten tons of tape to be wrestled into place, so blue painters tape will do the trick.

Birds Eye Figure

A common name for a small dot like swirling figure that is found most often in pieces of Maple, and can have a very attractive look for guitars. A birds eye fretboard is an especially good looking addition to a guitar, and looks great against the bright fret wire. The figure can happen in other species of wood, though it is not as prevalent as with Maple.

Bit

Common term for a drill bit typically, though it can also be used to refer to a router bit, dremel bit, or rotary tool bit. These are often small items that are inserted into a chuck or collet, and used to remove wood. The term is used interchangeably in any woodworking book, and will be used to refer to many different items.

Blade

A generic term for any cutting implement, electric or non-electric. Blades can be solid and fixed like on a knife or a razor blade. They can also be moveable like on a table saw, or flexible like on a band saw.

Blade Guard

A piece of plastic or metal that is designed to cover the blade while in use and help prevent accidental contact by the user of the tool. On a table saw the blade guard sits over the top of the blade, moving upwards as wood is pushed through. On a band saw it is a slider that reduces the amount of blade that is exposed during use. These guards are important, and should not be removed unless it needs to be for a specific cut. After that, it should be replaced, and always kept in the safest position.

Blade Stiffener

A thin metal disc that is placed on either side of a very thin and delicate table saw blade to give it some extra mass and thickness. These are used to prevent saw wobble, and also keep the saw blade from being damaged on a piece of particularly hard wood. They are sold for a specific arbor size as well as blade diameter, and the right set should be purchased for the blade that needs to be stiffened. These are the most common in guitar making when using a specially ground and super thin table saw blade to cut fret slots.

Blank

Any rough shaped piece of wood that will be used for a specific part of the guitar can be called a blank. The blank will be straight on all sides, and have no machining done to it except cutting it to approximate size. Blanks can be made for any part of the guitar, and they are often made several at a time in order to eliminate the first few steps from the construction process. Making and keeping several blanks for different parts

of the guitar saves time, because the shaping and cutting processes can begin immediately.

Blow Torch

An attachment for a small propane cylinder that produces a flame which can be adjusted for strength and intensity. These are most commonly used for heating a metal pipe for bending wood, and are easily found in any hardware store. A small torch and a flint igniter is adequate for guitar making, and a single propane cylinder will last a long time. Light the torch while pointing away from the body and anything flammable, and never leave a room with a propane torch burning.

Board Foot

Since wood comes in several different thicknesses, a method of calculating the amount of wood being sold needed to be devised. This calculation is based on a standard board foot, which is a piece measuring 1" x 12" x 12". To calculate how many board feet are in a piece of wood, measure the length, width, and thickness, and multiply those numbers together. Divide that number by 144 and the result will be the number of board feet. For example, a 4/4 board that is 6" wide and 60" long would be calculated as 1 x 6 x 60 = 360. Then, 360/144 = 2.5 board feet. If the price tag says $10 per board foot, this piece would be $25.

Bocote

A wood species native to Central and South America, Bocote is an excellent hardwood for using as fretboards and bridges. The wood itself has dramatically varying coloration, where almost black streaks can be found next to light tan streaks, and every color in between can be represented on the same board. The pieces available for purchase are usually medium to small in size, and they machine well. Bocote has a higher oil content, though the wood can typically be glued without any problems, and takes a finish really well. Moderately priced, but worth experimenting with.

Body

The part of the guitar that attaches to the neck is considered to be body of the guitar. The soundboard, back, sides, and bridge make up the

body, and it can come in many shapes depending on the model of guitar. Also see Soundbox.

Bolt On Neck

Normally used on electric guitars, but not as often on acoustic guitars, this refers to a system of joining the neck to the body with a number of bolts rather than using a dovetail joint or other means of joinery. Adding metal parts to the neck joint is considered a mortal sin by some, and a completely normal thing by others. The instrument makers of old never used mechanical fasteners to attach one part to another, though some have used nails. Bolt on necks have the advantage of being able to be easily removed and worked on, or replaced should the need ever arise.

Bone (Cow Bone)

Bleached and un-bleached cow bones have been used to make nuts and saddles forever, and they are still the most popular choice today. Bone is a natural material usually from femur bones in cows, and is dried and cut into blanks that are then sold to guitar makers. Bone is easy to work with, sands and files well, and has a warmer sound than plastic does. Wear a dust mask when working with bone to keep the dust out of the lungs, and be careful not to drop the blanks because they are fragile. Do not use bone with an under saddle pickup because the uneven densities of the material sometimes cause problems with certain strings being too loud or too soft.

Bracing

Used as a generic term to talk about the long thin pieces of wood used on a guitar top and back, to add structure and strength to the two plates. These braces are both structural as well as acoustic, as they shape and determine how a guitar will sound. Braces are typically made from Sitka Spruce, which has the highest strength to weight ratio of any known wood species. Sometimes other species are used like Douglas Fir, or Western Red Cedar, however Sitka is by far the most popular.

Brad Point Bit

A style of drill bit that has a center point at the tip, which centers the bit as it works its way into the wood. These will move around

less than a twist bit when starting the hole, and are typically easier to use for inlaying round dots.

Branding Iron

An electric or non-electric item with a metal piece at the end which is carved into a certain design or set of words. This end is heated and pressed against the wood, transferring the design as a burn mark. These can be used as a very efficient method of marking the guitar, and some can have removable and changeable letters or numbers for custom labeling. They can be purchased and customized online and through fine woodworking stores.

Brass Rod Stock

Sold in different diameters and lengths, this is a piece of brass that is shaped into a long rod with a certain diameter. It can be used for doing round brass inlays as side dots on the fretboard, or for brass dots on the end of bridge pins. These are normally found at smaller hardware stores, fine woodworking stores, and of course online.

Break Angle

The angle at which the strings pass over either the nut or the saddle is called the break angle. It comes from the strings breaking over the saddle or nut, which causes the termination of the string. A good break angle ensures that the strings only vibrate between the nut and saddle, and do not vibrate past them. The angle itself also increases torque on the top of the guitar, assisting in transferring vibrtional energy, creating more sound. Having a steep enough break angle over the nut as well as the saddle is an important detail to monitor while making the guitar.

Briar

The name given to the root ball or burl of the Heath tree, which is more of a bush, and contains a densely packed and intensely figured wood. Normally used for tobacco pipes, Briar is an amazing wood to work with, and can be used to make absolutely stunning bridges, peg face veneer, pick guards, and inlays. Due to the differing densities of the grain, the wood can be contrast stained, which involves staining the grain lines one color and the rest of the piece another. The effect this produces is striking to say the least, and adds lots of visual impact to the acoustic guitar. These must

be purchased from a tobacco pipe making supply store, which is most easily found online.

Bridge

The part on the top of the guitar where the strings attach, and which causes vibrations to be transferred to the soundboard. Normally made from Rosewood or Ebony, they are usually about 6" x 1-1/2" and only around half an inch thick. Sometimes custom carved and inlaid, bridges are a point of expression in guitar makers who choose to make them a bit more elaborate. Exotic wood species like Cocobolo, Briar, or Bocote make very striking bridges.

Bridge Holes

The six holes that are drilled for the strings to pass through are called the bridge holes, and they are normally drilled at 3/16". After drilling, the holes are tapered with a reamer that matches the same angle as the pins themselves, making a tight pressure fit that is difficult to pull free. A simple jig can be made from metal or hard wood that makes drilling these easier.

Bridge Pins

Small tapered wooden pins that go into holes on the bridge where they wedge in place, securing the string. They come in a variety of wood species, and can have decorations inlaid into their ends to give them a fancy look. They come in sets of six, and require a taper reamer to fit them into the bridge pin holes.

Bridge Pin Reamer

A hand tool with at least one cutting edge that is shaped like a long thin cone. The larger end of the cone is attached to a T handle, and it is twisted by hand. The taper of the cone matches the taper of the bridge pin, meaning that when the hole is widened with the reamer, the bridge pin will fit perfectly flush against the walls of the hole. The two angles will match, and a high friction fit will result. Reamers come in several different tapers, so find the one that matches the bridge pins being used.

Bridge Plate/Patch

The bridge plate is a thin piece of hard wood, usually rosewood, that is glued under the soundboard right below the bridge. This serves to tie the bridge and the soundboard together better, as well as give the ball ends something harder to rest against.

Book Matching

When a piece of wood is cut along the edge and opened like one would open a book, the grain forms a mirror image, which is called a book match. Imagine a closed book sitting on the spine with the page ends facing up and the book closed. If the book were opened at the middle and laid flat, that would be the same process as book matching a piece of wood. The edge is cut open, much like the book being split open, and the two halves are folded flat. The grain forms a perfect mirror match, and gives the best overall look to the piece.

Bubinga

A great alternative to Rosewood for backs and sides, with light red to pink coloring that deepens out with brown hues when finished. This wood species has an interesting figure, and strong grain lines which give the surface beauty. The wood bends easily, finishes like a dream, and makes a very pretty guitar. An inexpensive alternative to more costly woods, however the tone is bright and it makes a great sounding guitar. Easy to machine, even though the grain may be interlocking, and easy on edged tools as well. Bubinga is a pleasure to work with.

Buff

A term used to describe the process by which something is made smooth and glossy, through using rotating cloth wheels and abrasive compounds. It can also be used as a simple name for the cloth wheels themselves, often called buffs. See Buffing Wheel for more information.

Buffing Machine

A motor that drives an arbor with a buffing wheel attached, is called a buffing machine. This can be as simple as a low RPM swamp cooler motor, or as elaborate as a belt driven, dual wheel, professional buffing system. They are used to polish the finish on the guitar to a mirror gloss, and greatly reduce the time this process would take if done by hand.

Several are available through online guitar supply houses, though smaller outfits are available online as well.

Buffing Wheel

A buffing wheel is a cloth wheel that is attached to a motor, rotating the wheel at a specific speed. Abrasive compound is applied to the wheel while it is rotating, and used to polish finishes and smooth wood. Several buffing wheels are needed, one for each compound being used, and are commonly referred to as buffs.

Buffing Wheel Rake

This is thin piece of metal that has many small points on it, attached to a piece of wood that serves as a handle. The tool is held against the rotating wheel and it removes hardened and stuck compound from the buff, making it perform better. Hardened chunks of compound can sometimes scratch the piece being buffed, causing more work. Also, a wheel loaded with compound cannot take up any new compound, which diminishes the functionality of the wheel. These are inexpensive, and one will last a lifetime. Be careful not to press it so hard against the wheel that it damages the fibers or catches and throws the rake across the shop. Clean thoroughly between use to avoid contaminating other wheels with different grit levels.

Burl

When a piece of wood grows in a twisted and interlocked grain, causing a lump or deformation to appear on the tree, this is called a burl. This can be caused by damage to the tree, insects, or just naturally over time. The burl is cut from the tree, dried, and cut open, revealing a beautiful grain pattern that cannot be found in the rest of the tree. Burls are often made into fine veneers and other decorative pieces to get as much sellable wood as possible. Burls cannot be made artificially, so the price is usually higher for fine burls due to their rarity. Briar is an example of a burl, though many other species including Mahogany, Walnut, and Maple come in burl form was well.

Burnish

The method of putting a microscopic edge on a cabinet scraper using a piece of tool steel is called burnishing. A tool exists called a burnisher, that can be used for this purpose, though any hardened steel will normally work. This is the process of drawing out a burr, and turning it up so it can act as a cutter when dragged along the wood surface. This can be difficult for the beginner, so it is recommended to pick up a dedicated tool that takes most of the guess work out of it. Stewart MacDonald has a great burnisher, and so does Veritas. The variable burnisher by Veritas is easily the best and easiest burnisher to use, and it is built to last a lifetime.

Bushing

On a set of tuners, the small metal or plastic piece that is designed to be pressed into the peg head, and holds the tuning post in the center of the hole. They also cover up the edges of the holes drilled into the peg head, making them look cleaner. These bushings require a slightly larger hole than the tuning post, and are pressed into the peg head with hand pressure or by using a small bar clamp with rubber faces.

Butt Joint

A type of joint where the face of a board and the edge of a board are glued together without any reinforcement between them. The top and sides are an example of a butt joint, as well as the back and sides. On larger projects, biscuits, dowels and other methods are used to make the butt joint stronger, however on the guitar a piece of kerfing is used for the same purpose.

Buzz

A term used to describe the sound made when a string is accidentally touching a fret, or a funny buzzing sound is heard from the guitar while it is being played. This is a catch all term for any odd sound, and is most commonly caused by the nut being slotted improperly, the frets not being level, or a piece being loose on the guitar. If the nut is slotted too deep, the string can buzz at the nut. No more than half to three quarters of the width of the string should be sunk into the nut. If the frets are not completely level, the string can hit a fret wire and bang against it, causing a buzz. Remove the strings and level the fretboard to fix this. Less common is a piece being loose on the guitar, which rattles when vibrated by the energy

from the strings. When this is the problem, it is usually a brace or the kerfing. Add some glue under the brace or behind the kerfing and let it dry. The buzzing should be gone after that.

-C-

C-Clamp

A C clamp is a screw type clamp that comes in various sizes and the spines of which are all shaped like the letter C. These are often made of metal and can exert a large amount of pressure. Sometimes the metal jaws on C clamps can mar delicate pieces of wood, so purchase rubber covers for them or do not crank them down as hard. For jigs and for clamping things to the workbench temporarily, C-clamps are excellent, and easy to clamp and remove quickly.

CA Glue

CA is the short hand term for Cyanoacrylate, which is the long and fancy name for super glue. This is a quick bonding adhesive that can be used alone or with an accelerator spray that hardens the glue almost instantly. It is used any time two different materials are being glued together, like shell and wood. It is often used for inlays, since many different kinds of materials can be used and glued together. The nicer glues come in a few different viscosities from super thin to gel, depending on the preference of the user. A medium or thicker glue works well for inlaying because it stays where it is put, and does not soak into the wood very easily.

Cabinet Scraper

A thin piece of tool steel with a burnished edge used for micro-planing wood is called a cabinet scraper. These have been used for a very long time by many great woodworkers and instrument makers, and were the go-to tool before sandpaper was invented. They use a cutting action rather than an abrasive action to remove material, leaving a very smooth surface behind. Often preferred over sandpaper, cabinet scrapers do not need any further smoothing after the surface has been scraped. Unlike sandpaper, where several passes with finer and finer grits must be done in order to get a smooth final finish, the scraper leaves a very smooth surface requiring no further work. Invest in a good set of scrapers and a dedicated burnisher from a guitar supply house or from Veritas, and using this tool will be an absolute pleasure.

Cam

A cam is a lever that rotates, where the rotation causes something else to be moved. This is normally used where the rotation of the cam creates a linear type of motion in the other object. A cam lever is used on guitar makers clamps called cam clamps, and it pushes the clamping bar downwards, creating pressure on the items being clamped. The rotational motion of the cam is turned into downward or linear motion on the clamp arm.

Cam Clamp

A specific style of woodworking clamp that uses a cam lever and wooden jaws that are held in position with a metal bar spine. The wooden arms are positioned around the piece to be clamped and the cam lever is flipped. This causes the upper arm to exert pressure on the piece, holding it in place. These clamps are a favorite of guitar makers as well as woodworkers because they can be made in the shop easily and very inexpensively.

Carbide

Carbide is a metal compound that is extremely hard, making it ideal for cutting metal. It is also used in woodworking tools because the cutters are so hard that it takes wood much longer to dull them. Many familiar items have carbide tips or cutters like table saw blades, router bits, and certain dremel bits. The carbide is fused to a piece of tool steel which is used to carry and support the carbide. Most higher end cutting tools have carbide tips or cutters, making them cut better and last longer.

Carbide Cutter

A term that refers to a carbide tipped tool or a tool that uses carbide to remove wood such as a carbide dremel bit. See Carbide for more information.

Carbon Fiber Neck Reinforcements

These are very strong and light pieces of carbon fiber that are designed to be set in a guitar neck to give strength and prevent neck bow. They are specially made in the right size and shape for installing, and they add rigidity without adding hardly any weight to the neck. It is still a good

idea to have a truss rod for minor adjustments to the neck shape, but the carbon fiber rods are an added piece that makes the truss rod not have to work as hard.

Card Scraper

A common name for a cabinet scraper, see Cabinet Scraper for more details.

Carnauba Wax

This wax is collected from the leaves of a certain palm tree in Brazil, and has a very high melting point when compared to other waxes. It is used as a protective film over polished wood, a lubricant for wood on wood drawer slides, and can be buffed to a high luster. Guitar bridges that have been polished with Tripoli and White Diamond can be then buffed with Carnauba wax to impart a tough wearing thin layer of wax to protect the piece.

Caster

A strong plastic, rubber, or metal wheel that goes under a piece of woodworking equipment is called a caster. Some of them can spin around on a swivel, others are fixed in one direction. Casters on pieces of woodworking machinery can be useful in a small shop, because machines not being used can be wheeled out of the way for a while until they are needed again. This frees up space in the shop without having to lift heavy machines every time. Casters can be specially purchased for any machine, and standard sizes are available too. Check the weight rating to make sure the casters can stand up to the machine being placed on them.

Caul

Any piece of shaped or unshaped material used to aid in the effectiveness of a clamp. An example would be a curved piece of wood to aid in clamping a round item to a flat item for gluing. Cauls can be made or bought, though they are normally made right on the spot when they are needed. Any time a project requires a clamping caul, it can typically be made from scrap and used immediately.

Center Seam Reinforcement

On the back plate of an acoustic guitar, there is a piece of Spruce usually that is about 3/4" wide and the same length as the back plate. It is glued over the center seam on the side of the plate that will be on the inside of the guitar. The grain runs perpendicular to the center seam for strength, and is used as a safety precaution to protect the delicate center seam from splitting over time. This piece is normally glued in first, covering the entire seam, then it is chiseled out to allow the braces and head/tail blocks to be placed. An inexpensive soundboard can be purchased specially for this part of the guitar, and twenty or more strips can be sawn from it. This does not need to be anything fancy, just a piece of Spruce to match the rest of the braces.

Chamfer

A chamfer is the name for a flat bevel that connects two surfaces with an equal angle. A 90 degree corner that is cut off at 45 degrees would be a chamfer. The word chamfer is also sometimes used interchangeably with the word bevel, because they are similar looking.

Chatoyance

The effect in wood where it shimmers and reacts with light differently depending on the direction of the light that is striking it. In woodworking, this is done mainly with oils and shellacs, which give the wood an almost three dimensional look. The effect comes from the grain of the wood running in different directions, and depending on where the light is coming from, can have an interesting effect. This is also referred to as popping the grain, or grain pop. Some woods exhibit chatoyance better than others. A few examples of wood that can really pronounce this effect are Sapele, Curly Maple, and Figured Walnut.

Chisel

A woodworking tool used for carving, a chisel is an edged metal tool in varying widths that is used by hand or with a mallet. The handle holds the metal carving edge, and this metal edge has a bevel which can be sharpened. They come in several widths from as small as 1/8" to as large as a few inches. Chisels leave flat work behind them, due to their flat edges, and are a very important tool to use and understand for guitar makers.

Chisels have been used by woodworkers for about as long as metal has been used, and they still enjoy popularity today.

Chop Saw

A common name for a miter saw, see Miter Saw for more details.

Chuck

A type of bit holder where the outside is rotated, causing three or more small jaws to grab the bit, holding it in place. A drill has a chuck, which is where the drill bits are inserted, and so does a drill press. A chuck performs a similar function to a collet, however the range of sizes that can be put into a chuck are far more than the single size that can be used in a collet. Drills, drill presses, and lathes have chucks, while routers and rotary tools have collets.

Chuck Key

A small hand held adjustment tool that fits into the drill press chuck and tightens the jaws. By hand, the jaws of a chuck can only be tightened so well. This small tool that comes with the drill or drill press allows the chuck to be tightened very well, keeping the drill bits from falling out. These are typically made specifically for each drill, so be sure not to lose the chuck key. Replacements can be ordered from the original manufacturer online, and some generic keys are available as well.

Circle Cutter

This is an accessory for the drill press with a center drill bit and a horizontal arm that can hold one or more cutting blades. These blades are adjustable, and they rotate around the center drill as the machine runs. It is slowly ran through a piece of thin board or veneer to cut a circle with. The circle cutter can help with making rosette rings out of 1/8" thick stock, and they leave very crisp edges for gluing. The cutters are often replaceable, and can be ran many times before needing to be changed out. Invest in a circle cutter that has two cutting arms, which will balance better as well as cut a ring in one pass rather than two.

Circular Saw

A circular saw is a common term for a hand held electric saw that has a circular blade. It can be corded or cordless, and normally has a 4" to 6" blade depending on brand and quality. It can be used to make many kinds of cuts, and in most cases can be mounted to a bench to use as a table saw. These units cut well, however they are best used for construction quality cutting, rather than very fine woodworking. They will work fine as a temporary substitute for a table saw, though they do not have the same versatility.

Clamp

A generic term that can be used for any mechanical or non-mechanical type of holding device that is used in woodworking. There are many styles of clamps, including C-clamps, bar clamps, pipe clamps, cam clamps, and spool clamps. Each of these has their own usefulness in certain situations, and many of them will be used while making guitars. The shop can never have enough clamps.

Classical Guitar

The term classical guitar refers to a type of acoustic guitar made to be played with the fingers, and strung with nylon strings. Typically it has 12 frets to the body, a western red cedar top, and a completely flat fretboard radius. Favored by classical musicians for its warm tone and quick response to being played, the classical guitar also features a bridge where the strings are tied directly in place, eliminating the need for ball ends.

Clearance Notch

A small notch is cut in the bridge inside of each bridge pin hole, allowing the bridge pin to be pressed into the hole without hitting the string. These are normally made with a small saw, and allow the string to pass over the saddle at a better angle as well.

Climb Cut

When a cut is made in the same direction as the blade or bit would like to pull the piece, it is called a climb cut. Most often associated with the router, a climb cut would be a clockwise motion with the router, which is the same direction the bit is spinning, causing the router to be pulled slightly. This can be a really effective way of trimming the plate

overhang after gluing the guitar soundbox together, as a climb cut will reduce the chances of tearing out a chunk of the top or back while using the router. Just be careful that the router does not pull too quickly, which can become dangerous. Take shallow passes to reduce the chance that the router will pull too much.

Closed Gear Tuners

These are tuning machines that have covers on their gears, instead of allowing them to be visible. These can be removable covers, or they can be completely sealed inside the tuner housing, making them inaccessible for service or repair. This is not to say that closed gear tuners are inferior, it is simply a difference in construction. There are many closed gear tuning machines that are superior pieces of hardware, and it is the most common design when compared to open geared tuners.

Closed Grained

Any wood where the pores which transport nutrients while the tree is alive cannot be seen with the naked eye are called closed grain woods. These pieces do not require any additional filing of the pores before finishing, because they are so small. Examples of closed grained woods are Maple, Spruce, and Western Red Cedar.

Closed Pored

This is where the pores of the wood are so small that they cannot be seen. See Closed Grained.

Clothespin Clamps

Small clamps that are made by adding a rubber band to spring style clothespins are called clothespin clamps. There are used mostly for gluing the kerfing to the sides on acoustic guitars or the linings to the ribs on violins. Born out of the necessity for many clamps that would only be used once in a while, some innovative luthier out there figured out that a clothespin and a rubber band was a great and inexpensive way to make a hundred quick little clamps.

Collet

A part of a power tool that holds a rotating bit is called a collet. These are found on routers and rotary tools, and they are what apply pressure on the bit to hold it in place. Routers can come with a choice of two collets, or they can be interchangeable. These are most often 1/4" and 1/2", which correspond with the shaft size of the bits. Different from chuck, a collet is sized for one shank diameter only.

Collet Adapter

Router collets come in 1/4" and 1/2" commonly, though there is a piece that can be used to convert the 1/2" to a 1/4". The collet adapter is a small insert that goes into a 1/2" collet, and has an opening that is 1/4" wide. A 1/4" bit can be inserted into this adapter and the collet tightened like normal. Any router with a half inch collet can use a collet adapter, allowing the router to use any size of bit. The conversion does not work in the other direction, so when in doubt, buy a router with a 1/2" collet and use the adapter for 1/4" bits. This way almost any router bit can be used no matter the shank diameter.

Combination Square

A combination square is made of a ruler and another piece that slides onto the ruler and can be used to measure different things. The most common attachment to the combination square is a right angle piece that has a scribe and a level, and is used to check 90 degree angles. It is also used to take small pencil marks and mark a longer line that is 90 degrees to the edge of the wood. Other attachments include a Y shaped piece that allows the centers of dowels to be marked accurately, and another that is an angle finder for marking a precisely measured angle.

Compass

A compass is a metal implement with a pencil on one side and a metal point on the other, and is used to draw circles. The A shaped item is adjustable, and can assist in making very accurate circles of a specific diameter. A compass can be useful in marking out the soundhole, and for cutting a rounded profile on the end of the fretboard where it overhangs the body. For guitar makers, a compass with a six inch maximum opening is all that is needed, since most of the time anything larger will be drawn with a ruler and string.

Compensated Saddle

A saddle that has specific bevels along the top where the strings make contact, which change the string length slightly to improve the intonation is called a compensated saddle. These come pre-made now, and they are adjusted fairly close to where they need to be for most guitars. Purchase a compensated saddle instead of a standard saddle, and the intonation will improve just with that one change. They come in bone, as well as a variety of plastics, and will take much of the work out of the initial intonation.

Compensation

When referring to string compensation, this means the amount of extra scale length the string needs in order compensate for the raise in pitch from fretting the string. When a string is fretted, it is stretched very slightly. This stretch raises the pitch slightly as well. Making the scale length a little longer to compensate for this stretch means that the fretted notes will sound correct, even though the string is being pressed against the fret. Saddles are angled slightly at the bridge so that the strings can be compensated for, making the resulting pitches all sound more in harmony with each other.

Compound Miter Cut

A cut where a miter and a bevel are made at the same time. See Compound Miter Saw for more details.

Compound Miter Saw

A miter saw that can make bevel cuts as well as making miter cuts is a compound miter saw. Most miter saws only have one angle of adjustment for making miters. A compound miter saw has two angles of adjustment, and is very useful when a miter and a bevel are required at the same time. They can also be helpful in cutting the heel of the neck to have a slight back angle, making the neck easier to play.

Compound Radius

When referring to fretboards, those that have a different radius at the nut than they do at the 20th fret are said to have a compound radius. Essentially what this means is that there is more than one radius on the

board, so it is said to have a compound radius. These require several sanding blocks of different radii, and lots of patience to put on a fretboard, however they are preferred by players who enjoy playing in the upper register especially. The radius starts out tighter at the nut and becomes progressively flatter as the higher frets are reached.

Contrast Staining

This involves staining the grain of a piece of wood (usually Briar) a very dark color, and staining the rest of the piece a light color. The main colors used on the darker grain are dark brown and black dye stain, which affect the darker grain because it is less dense than the surrounding wood. Once the whole piece is stained black, the majority of the stain is sanded off, leaving only the grain still very dark. A lighter colored stain, usually a red, orange, or yellow is used afterwards which stains the rest of the wood, and evens out the overall look. This creates a striking difference between the grain and the surrounding wood, which adds depth and character to the Briar. A similar technique can be done on Walnut as well, though not to the exact same degree as with Briar.

Coping Saw

This is a saw with a removable blade and a deep throat which can be used for making inside cuts in wood. The spines and handles vary from model to model, but the blades are similar to scroll saw blades, meaning they are small, thin, and make very clean cuts. A coping saw is an inexpensive alternative to a scroll saw, and can work with thin wood in much the same capacity as a band saw. Blades vary depending on the material being cut, and can be specially made for cutting wood, metal, or shell for inlaying.

Copper Rod Stock

Lengths of thin rod in varying diameters, sold in smaller hardware stores and online, and are made of copper. This material can be used in the same way the brass rod stock is used, and it makes excellent inlay dots and fretboard side markers. Once inlaid it requires sanding and polishing to come up to a nice luster, and the piece will retain its shine if sealed with a clear finish. These can be found in smaller hardware stores as

well as online, and are very inexpensive for how many dots can be cut from them.

Cork

A very soft wood material used for lining clamp faces and for protecting instruments from scratches while resting on support cauls. This can be found in office supply stores in rolls that are normally used for making cork boards. Purchase a whole roll because it will be used very often throughout this book, and any time a softer face is needed on a tool or jig.

Counter Bore

Any drilled hole that has a flat bottom and straight sides can be called a counter bore, and it is a term used for both the hole and for the bit that makes the hole. A Forstner bit is a counter bore bit, which makes a counter bore hole. This is most often used in conjunction with another smaller hole in the center, which would be where the bolt shaft would pass through. The counter bore recesses the head of the bolt into the surface of the wood, keeping it out of the way.

Counter Sink

Referring to a style of hole made in a piece of wood where the pilot hole for a screw is beveled, so the screw head sits slightly under the surface. The bit used to make the beveled hole as well as the beveled recess are both called countersinks, and in guitar making the bridge pin heads are countersunk a little ways. Countersinks are most often used with wood screws that have beveled heads, matching the depth of the countersink to the size of the head, and sinking it below the surface slightly.

Course

The number of double string segments on an instrument is called the number of courses. Where a single string instrument is called a 6 string, a 12 string would be a six course instrument. Any pair of strings that sit closely, and next to each other, that are meant to be played together every time is called a course. A Bouzouki and a lute are two examples of instruments that are double strung, and are referred to as having a certain number of courses.

Cross Cut

A cut that is perpendicular to the grain is called a cross cut. These can be done on a table saw, with a circular saw, or with a hand saw. Any cut, no matter the length of the board, that goes perpendicular to the grain is a cross cut. Most often, this is the second step after a piece is ripped to width on a table saw.

Cross Linking

When chains of molecules link together as they dry in a strong and solid way, this is called cross linking. As the finish cures, oxygen causes the molecules to link together, which is why the finish dries on the surface. There are things that companies do to increase this effect, like adding metallic driers to the formula to make the finish absorb oxygen faster, or cooking the finish to get the cross linking to happen while the finish is still wet. All of these things get the finish to dry quicker, set up harder, and allow it to be buffed to a gloss in most cases.

Cure

When a finish has completely rid itself of any non-solid ingredients through evaporation, it is said to be cured. Finishes can take several days to several weeks to cure fully, and it is best to leave them a little extra long to ensure a complete cure. Before any buffing or rubbing out of a finish, it needs to be allowed to cure, otherwise it will not be hard enough to work with. A test as to whether or not a finish has cured is to smell the finished piece. If a solvent smell or chemical smell is still present, the finish has not cured yet, and still needs some time. Wait a couple weeks before smelling the finish in order to minimize the smelling of harmful chemicals. For most finishes, it is not worth checking until at least a week to ten days has passed.

Curved Chisel

A long bladed chisel where the blade is curved to keep the handle from hitting the work surface while carving. These are useful when carving the profiles of braces because the handle of the tool does not need to be brought down so close to the piece. This extra room makes it easier to maneuver the tool around, and helps make carving the top and back much quicker. A standard chisel can be used with the bevel facing down to get the

same effect, which raises the handle high over the braces. This way, very thin cuts can be made with a flat chisel as well.

Cutaway

A cutaway is a feature on the upper bout of the guitar, on the treble side of the neck where the fingering hand plays. It is a removal of a portion of the upper bout area, allowing access to the higher frets, and is made into a decorative feature on the guitar body. When a tight bend is made to produce the cutaway, it is called a Venetian cutaway, and when the cutaway is brought to a sharp point, it is called a Florentine cutaway. Cutaways do reduce the volume of air inside the guitar body, which will affect the tone, however not to the point where it cannot be balanced out somewhere else on the guitar.

Cutoff Wheel

An attachment for the rotary tool, these are abrasive discs held by a mandrel that are used to cut metal. They do so by abrading the metal in a very small area, effectively sanding through the piece. A cutoff wheel can be used to trim a truss rod to length, take off fret ends, and any other time a small piece of metal needs to be cut. The wheels will throw a lot of sparks, so wear eye protection as well as gloves, and make sure the sparks do not hit anything flammable.

Cutting Edge

On any edged tool, the sharp part of the tool that removes wood is called the edge, or cutting edge. These are found on all cutting tools from planes to scrapers, and the term refers to the actual sharp portion making the cut.

-D-

Dado

A dado is a trench or a slot that is cut into a piece of wood, usually with a dado blade on a table saw or a router and a straight bit. The can be seen as a slot that goes into the surface but not all the way through, having straight sides and a flat bottom. Dados are used to sink one piece of wood into another for a larger gluing surface and to add mechanical support to a joint.

Dead Blow Hammer

A dead blow is a specially made hammer that does not bounce back when it strikes a surface. This is normally accomplished by filling the head of the hammer part of the way with lead shot, which absorbs the bounce back. These hammers help control the force better, and minimize damage to surrounding areas through their design. They are normally made out of plastic with a hollow head where the lead shot resides.

Deep Throat Caliper

A thickness caliper with a very deep throat for checking the thicknesses on guitar tops, sides, and backs. Having a dial readout, these calipers allow the tool to take measurements deeper into the center of the piece, where a standard caliper could not go. The thicknesses at different points are important to check often when hand planing and scraping a piece of wood, in order to keep from removing too much material. Calipers also give quick feedback about the thickness of the wood because they are easy to read, and take a reading quickly.

Defects

A catch all term for variances in a piece of wood, which can include knots, holes, insect damage, or cutting damage. Any of these are considered not to be what the natural piece of wood should look like, and are to be avoided when possible during wood selection. Some smaller defects in color are not an issue acoustically, however once the finish is added it may greatly enhance the color difference. Avoid knots if possible,

and holes and insect damage as well. Try to select a board that has a uniform coloring, is free from large defects, and is straight grained.

Depth Stop

These come in many varieties and they are sometimes specially made for the tools they are being used on. The depth stop is set to allow the tool to operate until a certain depth is reached, then the tool can advance no farther. A drill press can have a depth stop that will limit the travel of the head to a certain point, stopping the motion of the arm once that point is reached. These are useful in many ways because they can force the machine to make a series of similar holes, or make one hole that is precisely the correct depth.

Diagram

Any technical drawing, or drawing that is designed to explain or show how something functions can be called a diagram. There will be many of these throughout the book, and they are common in all woodworking and guitar making books.

Dial Caliper

A precision measuring tool, the dial caliper is a metal tool with a set of jaws that turn a dial when opened or closed. The movement of the jaws is connected to the dial, so it will show a measurement of how far open the jaws are. It is very useful for making precise measurements down to a thousandth of an inch. When measuring tuning posts and selecting a drill bit, a dial caliper can help find a drill that is just a tiny fraction larger than the posts, making an excellent fit. They can also be used in measuring precise distances, like the distance between the strings at the bridge.

Diameter

A term commonly associated with circles, the diameter is the distance from one edge of a circle to the other edge, passing through the center. In guitar making, the diameter of the sound hole is usually around 4". The diameter of a circle is also exactly twice the radius.

Diamond Braces

These are small square pieces of wood, usually no more than 3/4" on each side, that are beveled around one face, and used to reinforce the center seam on the top. They are placed near the lower tone arms and directly over the seam. The piece is positioned so that the grain is perpendicular to the grain of the top, making it stronger. They are super small, with beveled edges so they do not affect the acoustics of the guitar in any noticeable way. These can also be placed under the top should a crack ever need to be repaired, and will help to hold the repair together.

Die

A die is a tool used to put threads on a metal rod, which is useful when making truss rods. The tool itself is a small piece of metal with a hole in the center, and small cutters that replicate the needed thread pattern. A metal rod is inserted in the die, and the die is turned as if screwing it onto the rod. The small cutters inside the die remove metal, creating threads, and the die is then unscrewed. A nut of the same size as the die can then be threaded on the rod.

Die Wrench

This tool is used to hold a die when threading a metal rod. It is a simple T handle with a space in the middle to place the die, and a small knurled screw to hold it in place. See Die for more information.

Disc Sander

A type of machine sander that uses a rotating metal disc which sandpaper is stuck to. There is a table in front of the wheel where a piece can be laid down while working on it, and the angle of the table is adjustable. Many times a small disc sander is included on a belt sander, making a belt/disc sander combination. The discs are available in many different sizes and grits depending on the size of the machine and the sanding requirements.

Double Neck Guitar

A guitar, either electric or acoustic that has two necks attached to the body, both of them strung up and playable. One neck may be tuned differently than the other, or one may be a bass or twelve string neck alongside a standard six string. These guitars are typically for show more

than they are for performance, because the sound is never really as good as a properly made single neck guitar.

Double Stick Tape

This is a specially made clear tape that has adhesive on both sides. It can be bought at a craft store or an online guitar supply house, and can be used for holding pick guards in place. Custom made veneer pick guards can be lined on the back side with double stick tape, then pressed to the face of the guitar. They will hold forever, or until a thin knife is used to pry it off for replacement. Using double stick tape eliminates the need for screwing the pick guard on, meaning more than one style of pick guard can be used on the same guitar without filling it with holes.

Double Strung

This is a term for instruments that use two strings very close to each other that are meant to be played together at all times. Instruments that are double strung include Mandolins, Bouzoukis, and twelve string guitars. These instruments have a fuller sound and thicker feel to the music they produce, because they simulate the sound of two instruments playing at once. Each set of two strings is called a course on double strung instruments.

Douglas Fir

Douglas Fir is a common name for an evergreen tree that grows in the northern regions of North America. It is commonly used in guitar making as well as violin making, and makes excellent braces for the backs of guitars. Douglas fir can have a spectacular number of grain lines per inch, giving it tremendous strength when flexed, and it is very easy to shape and carve. It can be used for instrument tops, braces, and center seam reinforcements.

Dovetail Joint

A classic joint in woodworking, and a classic joint in guitar making between the heel of the neck and the body. The dovetail joint combines the extra gluing surface and sharing of wood in a mortise and tenon joint, and adds the mechanical strength of a locking joint as well. The dovetail shape is cut on the heel of the neck as well as the head block of the

guitar, and these two cuts are shaped to fit precisely inside one another. The only direction the neck can be removed is by pulling it upwards, which can never be done once the fretboard has been glued in place. The tension of the strings can never pull the neck from the body without ripping off the wood on either the heel or the head block.

Dowel

A short cylindrical piece of wood with a specific diameter. The diameter is normally small, somewhere from 1/8" to 2", and they are sold in 1" lengths. Dowels are used to reinforce joints between larger pieces of wood, helping to hold them together better. Specially made fluted or spiral cut dowels are mainly used because the glue can squeeze around the dowel better than straight sided dowels.

Dowel Center

A small metal cylinder of a specific diameter, with a point on one side in the exact center of the cylinder. These are used to mark drilling locations for making accurate dowel joints. Of the two pieces to be joined by dowels, one is drilled, and the points are inserted into the holes. The second piece is lined up, and it is bumped against the points, leaving marks where the piece will need to be drilled. The two drill holes should line up perfectly when the two pieces are put together. These are very useful in making a dowel joint between the neck and body on the guitar.

Dowel Rod

Made by machines, these long wooden rods of a consistent diameter are available in many species and sizes. They can be used for inlaying round fret markers when cut into short segments, and they can also be used for dowel joints. Exotic wooden dowels can be purchased online for very easy fret dot inlays, and one dowel rod will literally make hundreds of dots.

Down Cut Bit

Router and rotary tool cutters that turn downwards while the bit rotates in the tool are down cutting bits. The cutting edges wrap around the bit with a certain kind of twist, and when the bit rotates this twist causes the sharp edges to cut downwards or cut upwards. The downward cutting bits

leave no fuzz on the top of the slot being made, which makes inlaying easier because the pieces fit better. Carbide down cutting bits for the rotary tool or the router are the best that can be bought for inlay work, and leave a better edge when finished.

Dozuki

The proper name for a style of hand saw that is popular in Japan, and cuts on the pull stroke instead of the push stroke like American saws do. Making the saw cut on the pull stroke allows the tool to be far thinner than push saws, because the blade does not need to support itself through the push cut. The blade is pulled and always stays flat because there is no pressure to bend it. This allows a far thinner kerf, and much less wasted wood. They are available in many different styles, though they always will cut on the pull stroke. This can be a little difficult to get used to at first, however a well made Dozuki is a precision tool that is a pleasure to work with.

Drawknife

A drawknife is a traditional woodworking tool that consists of a thin blade about 8" long with a handle at each side. The handles and the blade are shaped in such a way that the tool can be pulled towards the body and the knife will remove shavings of wood. They require sharpening and honing like any other edged tool, and they are great for removing the bulk of the waste when carving a neck. The depth of cut and the amount of material removed with one pass can be adjusted by the amount of pressure applied and the angle at which the tool is used.

Dreadnought

The dreadnought shape is a classic shape for western style steel string acoustics, and the extra body volume places more emphasis and power on the bass notes and open chords. This is a far more boxy shape than a classical guitar or an orchestra model, but the loss in aesthetics is made up with the increase in tonal response in the lower notes.

Dremel Tool

A common term for a rotary carving tool is a Dremel tool, which is a brand name and not an actual tool name. The Dremel company

makes the most popular and most used rotary tool, so the terms are used interchangeably. These tools are hand held with a rotating tip that has an adjustable speed. The collet holds small burrs, sanders, and cutting bits that can be used for a variety of tasks. The bits are normally small, and used for carving. There is a router type attachment where the Dremel gets a plunge router base, which can be very useful for inlay work. The circle cutting attachment is great for rosette inlaying and cutting out the soundhole, and makes both processes far easier.

Drill Index

A group of drill bits, organized in a container by size is called a drill index. These are sold in standard as well as metric, and they are easy to find. A large set may have 60+ drill bits, and a small set may only have 8-10. They can change size by 1/8" between bits, or as little as 1/64". A drill index that contains bits from 1/16" to 1/2" in increments of 1/64" is perfect for guitar making.

Drill Press

A drill press is an electric tool that combines a drill with the precision of a solid head. The drill is mounted in a fixed position, and the head can be made to move up and down. The drill press will always drill at a 90 degree angle to the surface of the wood, and will always drill straight through. It is much easier to make straight holes with a drill press than a hand drill, because it is hard to line up the hand drill left to right as well as front to back at the same time. These can be small bench top models, or large floor standing tools that can use very large drill bits.

Drill Press Vise

A small vise that sits on the drill press table and is used to hold small parts for drilling. These are helpful in shaping saddles since they can hold the length of the saddle while allowing room for the bevel to be carved with a file. They can be clamped to the drill press table if needed, and removed when not needed. Some drill press vises have rotary knobs that allow the vise to be moved in a certain direction by cranking them. Most however are simple vises that are small enough to use on the drill press.

Drop Shoulder

When the treble shoulder of the guitar is bent and fitted to the body at a higher fret than the other shoulder, this is called a drop shoulder. Normally a steel string neck meets the body at the 14th fret, which means anything past that is hard to reach with the fingers. Dropping the bottom shoulder to meet at fret 17-19 means more access to the higher frets and a guitar with a more playable fretboard. There will be a loss in air volume which will have to be made up in another dimension of the body, however the upper face of the guitar is relatively inactive, so dropping the shoulder does not hurt the sound much.

Drum Sander

A machine sander that has a rotating drum covered with abrasive paper that evenly removes wood is called a drum sander. They can be made in several sizes, and are often times open ended, meaning a piece twice as wide as the drum can be passed through twice to do both sides. This is often used to get the plates and sides to final thickness after they become too thin for the planer. Most drum sanders are table top models, though very large sanding machines are also available. They are very convenient for sanding and for thinning pieces of wood. Take very thin passes to avoid burning the wood, or jamming the machine.

Dry

When a finish is no longer sticky, it is considered to be dry. This is very different than cured, which means all of the non-solids have completely off gassed and the finish is as hard as it will get. Dry simply means that the surface is ready for another coat of finish, or the surface is fine to be handled very lightly. Drying can take several minutes to several hours depending on the product being used, and should always be given a little extra time over what the label says. See Cure for more information on finish curing.

Dry Brush

A dry brush is simply an unused paintbrush that can be used to brush away sawdust from a part of the guitar to reveal any scratches or areas that still need attention and smoothing. As sanding dust builds up on the surface of the guitar, it fills the small cracks and scratches, making them appear like they are better looking than they really are. Having an easy way

to remove the sanding dust is a great way to check progress as the piece is sanded. Only use the brush for wiping away sanding dust, and never for anything else. Hang it somewhere where it will not get dirty or become contaminated with any oils or grease.

Dual Action Truss Rod

A dual action truss rod has two metal bars that move together causing the neck of the guitar to be forced backwards. The first rod is pulled forward by the turning of the adjustment nut, causing the end of second rod to hit a metal piece. The rod cannot advance any further, so it presses backwards along with the first rod. This is the standard style of truss rod inside a guitar, and the easiest to build in the shop. It will create high backward pressure, and can easily force the strings against the fretboard with a small adjustment. A classic and powerful truss rod design.

Dust Collector

A large vacuum type tool that traps sawdust and airborne dust by sucking it through a filter, depositing the solid particles in a bag. These tools are sold in many sizes depending on the size of the shop and the number of tools that will be connected to the system. Pipes are ran from each tool to the dust collector, which vacuums away the dust as it is being made by the machine. It is recommended to have a dust collector in every shop, and it can be as simple as a shop vac that is connected to each tool when needed. A small canister dust collector will cost about the same as a small power tool, and will make a significant difference in the cleanliness of the shop, as well as the quality of the air.

Dust Mask

The small white masks used by painters and woodworkers to keep small floating debris from being inhaled while working are called dust masks. They are nothing more than protection from particles, and will not protect against chemicals or vaporized solvents, but they are better than simply using nothing to protect the lungs. A dust mask should be worn every time wood is sanded or carved, because the small particles created can lodge themselves in the lungs and cause problems down the road. Over time a condition called Silicosis can develop, which is fatal, and there is no known cure.

Dust Nibs

When particles of dust land on a finish while it is drying and become trapped inside, they are called dust nibs. They can be felt by running the fingers over the dry finish, and can usually be seen as well. The only way to remove them is to sand through the finish until it is level, and then apply more coats. Make sure to apply the new coats in an area where there is not any floating dust, otherwise the new coat will have the same problem.

Dye Stain

Different from a pigment stain, dye stains color a board without obscuring the grain. A dye colorant is mixed with either alcohol or water and then brushed or wiped on the surface of the wood. The dye colors the wood, and when the water or alcohol dries it can be finished like normal. Dyes will darken with successive coats, but will not obscure the natural grain of the wood like pigment will. They are also referred to as aniline dyes.

Dyed Veneer

Pieces of light colored veneer are often ran through a dying process where they are colored very intensely, usually in colors not found in natural wood. These pieces are dyed completely through, and can be cut, sanded, and finished without losing their coloring. Dyed veneer can be used for interesting rosettes, and over the top peg head veneer. It can also be made into custom pick guards, or used anywhere that regular veneer would be used.

-E-

Early Wood

The wood formed by the tree in the spring that has wide cells and is lighter in color. The cells are formed larger because the tree needs to get nutrients and water to its leaves rapidly. Once this phase of tree growth is taken care of, and the tree can feed itself well, the rings start getting thinner again. Early wood is lighter in color than late wood, and the contrast between the two types is seen as rings.

Ebony

A beautiful dark black African wood that is very dense, and is used for bridge pins, bridges, fretboards, and peg head veneer. Most Ebony is not in fact jet black, only rare and high quality Ebony is this way. Many pieces of Ebony are died to even out their coloring once they are used on a guitar. Special black dye is used sometimes, though any black dye stain will work just as well. This will even out any lighter streaks, as well as give the flat, almost stone look that makes Ebony so popular.

Edge (Of A Board)

The edge of a board is the area on either side of the faces that is not end grain. These are normally the longer edges, but on very small cutoffs this may not be the case. The edge will have a grain pattern that does not show end grain, and it will be on either side of the face of the board.

Edge

The sharp portion of a cutting tool. See Cutting Edge for more information.

Electric Module

A generic term given to the small electric units that are installed into the side of the guitar that hold the battery and the tone adjustment sliders. These can vary in size, but they are all typically installed in the side somewhere, and it is a self contained unit. Some of these will have

connections for an under saddle pickup and or a microphone to pick up the sound, and then send it to the amplifier. Install for these is a matter of making a hole in the side of the guitar with a Dremel or chisels, and screwing the unit in place. The pickups are connected and installed, and an input jack is installed. This easily converts an acoustic guitar to an acoustic/electric.

End (Of A Board)

The part of a board that is not on the faces, where end grain can be seen, is the end of a board. These are typically the smallest two surfaces on a board, and are normally found at either end. End grain is most times darker and may look like a bundle of fibers when looking directly at it. On a 12" x 48" x 1" board, the 12" x 1" areas would both typically be the end grain of the piece.

End Flash

A piece of wood inlaid into the bottom of the guitar to hide the joint between the sides. See End Graft for more information.

End Graft

The term for the piece of wood that is inlaid at the bottom of the guitar by the end pin. This inlay is used to conceal the joint between the two pieces of wood used to make the sides. It can be simple and small, or it can be larger and more eye catching. The end graft is also called the end flash or end cap.

End Pin

The end pin on the guitar is located on the bottom, where the two boards that make up the sides meet. The end pin goes in the bottom of the guitar and the strap attaches to the pin, allowing the guitar to be played while standing. These are made of a variety of woods, though they are usually matched to the bridge pins for aesthetics. Rosewood and Ebony are the most common two choices.

End Pin Jack

For acoustic/electric guitars, this is an input jack that replaces the end pin, so no more holes have to be drilled into the guitar. The end pin

will still function for attaching a strap, however the guitar cable will plug into it as well. This is a nice way to conceal the electronics, especially if a transducer is used, which will not have any visible electric components.

English System

A system of measurement dating back to the early 1800's where a standard of measures was enacted by law. This is widely used in the United States, and has different relations for different measurements. One foot is divisible into twelve inches or multiplied by three to become a yard. A mile is 5,280 feet, which is 1,760 yards, or 63,360 inches. To further complicate things, inches can be divided into fractions of an inch based on dividing by two over and over, or they can be expressed in fractions of an inch based on the decimal system. It is not uncommon to see a measurement for 0.890" right next to one for 3/4". This only makes sense if you were born in America, which I was, so I understand this completely and am terrified of the metric system.

Epoxy

Epoxy is a type of adhesive that comes in two parts that are mixed before using them. Once the two liquids are mixed, they begin to harden and form a very strong bond. Epoxy comes in many types, however a clear 30 minute setting type is the best for guitar making. Inlay is done with epoxy many times, because it is great at bonding a non-wooden piece to a wooden piece.

-F-

F-Hole

The decorative openings found on the tops of violins and arch top guitars are called F-holes, and they serve as openings where the pressure inside the soundbox can escape. They also weaken the area of the belly between them, allowing the plate to vibrate better. They come in many shapes and styles, though they are all similar, and each maker tends to have their own style for cutting the f-holes in the top. F-holes can be used instead of a soundhole on an acoustic guitar, though there will have to be changes made to compensate for the difference in the size and placement of the openings.

Face (Of A Board)

The face is typically the largest surface on a piece of wood, and where the grain can be seen the easiest. On a piece of wood that is 12" x 48" x 1", the 12" x 48" areas on both sides would be the faces.

Face Shield

A piece of protective equipment that goes on the head and adjusts to the user. A large clear plastic piece flips up and down, covering the face and protecting it from flying debris. The shield can be flipped up when not needed, and flipped down when protection is required. Often used on the lathe, a face shield comes in handy when using a rotary tool, router, or any other time safety glasses are just too small to do the trick.

Feather Board

Used in the table saw as a safety and guide device, the feather board is a simple piece of wood with several parallel cuts made in it. The end of the board is then crosscut on a small angle. These cuts and the angle allow the end of the board to flex a little in one direction more than another. The board is placed on the table top and clamped down where it can be touched slightly as the board being cut passes through. The fingers flex and hold the board against the fence, and dig in if the saw tries to kick back the board. They are easy to make, or can be bought already made from a fine

woodworking store. It is a simple and effective tool that improves cutting accuracy as well as safety.

Feeler gauge

These come in a set, and are very thin sheets of metal that are of a certain thickness. They are used alone or stacked up to reach a certain size, and are stuck into a crevice to measure it. Feeler gauges are useful for slotting the nut, because the depth of the slot can be measured accurately, which is hard to do with any other measuring tool. These are common in the automotive industry for setting spark plug gaps, and the set looks like a pocket knife with several blades of different thicknesses.

Fence

A moveable horizontal beam that can be locked in place, leaving a certain sized gap for wood to pass through on a machine. The wood being cut is pressed against the fence, which keeps it straight as well as keeps it a certain distance from the blade or cutter. A fence will be as wide as the entire table top of the tool, and is most commonly found on a table saw for rip cuts, and a router table for edge profiling.

Figure

When referring to the pattern and the position of the grain on a piece of wood, the word figure is used. All pieces of wood have figure, though some plain pieces have almost none. Burls have a lot of figure, and plain pieces of Spruce have very little. When buying wood, pieces that have a very high figure will often times cost more because they are rare, and hard to come by. Less figured pieces will sell for the standard market price, because they are common.

Figured Wood

Pieces of wood that exhibit large amounts of figure. See Figure for more information.

File

This is a hand tool that is made of metal with small teeth or grooves that are designed to remove wood or metal. These grooves are all the same size unless it is a multiple sided file, in which case it will be easy

to see the coarse and fine sides. These are most often used in woodworking for rapid wood removal before some type of sanding or scraping is done. Files are made specifically for wood and for metal, so purchasing one for a specific material is important. A few files in different shapes are versatile tools to have in the shop.

Film Finish

Any finish that sits on the surface of the wood rather than sinking in, and can be built up as a layer is called a film finish. Varnish, lacquer, and polymerized oils are all film finishes, because they all add a surface layer to the wood. These offer more protection than penetrating finishes, because the layer of finish takes the direct hit from any object that might damage the wood, rather than the wood taking the hit. Film finishes can typically be buffed to a high gloss if desired, and tend to keep their gloss longer.

Fine (Grit)

When referring to grit levels, or the amount of abrasion being done, a fine grit is the opposite of a coarse grit, and removes very little material. Fine grit sandpaper would be in the 320 range and higher, though an argument can be made for going as low as 220 for fine grit in woodworking. Fine papers clean up the scratches left by coarse papers, and leave a smoother surface behind.

Finger Braces

These are the tiny braces that are seen on the underside of a guitar top, coming off of the x-brace at about the three and nine o'clock positions. There are normally two of them on either side, and they are not wider than 1/4" and around four inches long. The ends are tucked under the x-brace slightly to keep them from falling off, should some of the glue fail in the future. They serve to stiffen the soundboard and transfer vibrations.

Finger Plane

A very small plane often used in violin making, but popular with guitar makers for carving the braces into a parabolic shape. These very sharp and tiny metal planes are held with the tips of the fingers and used to remove small bits of wood with each pass. They are expensive for their

size, however they have many uses and are a fine tool to work with. Shaping the braces with a chisel can get a bit tough, and a small plane like this really makes the job easier, especially in tight spaces. Small planes can be used when carving an electric guitar top, or when carving an arch top guitar.

Fingerboard

The piece of wood (usually Ebony) on a classical instrument where the fingers press the strings to make certain notes. These are not fretted, and have a tight radius with a slight relief along the length. A fretless bass and a violin both have fingerboards rather than fretboards, though the terms tend to be used interchangeably.

Fingerboard Stain

Normally used on Ebony to dye it a uniform color and remove lighter streaks, fingerboard stain is a deep black stain that masks some of the lighter shades found in Ebony. This stain is applied to any piece of Ebony that has uneven coloring, and it drops everything to a solid black color. Not all Ebony is jet black throughout the piece, so stains are used to even out the coloring and keep the price of the guitar to a reasonable level. Only the most select pieces of Ebony are truly jet black throughout the wood, and they cost a small fortune to purchase.

Finish

Any product that is used as a coating over the instrument to protect it from wear, water, and dirt can be called a finish. Finishes can be as simple as a coating of oil, and as elaborate as a multiple layer finish containing several different products. The term finishing also refers to the act of finishing the wood, meaning the application of a finish. A finish is the final step in making anything out of wood, and protects the piece during its life.

Fixed Bridge

A fixed bridge is a bridge that cannot be moved once it has been placed. Bridges like this are screwed or glued to the instrument, making their position fixed, which is how acoustic guitars and electric guitars are made. The advantages of a fixed bridge are that it does not have to be

adjusted and placed correctly every time the instrument is tuned, and it guarantees that the frets sound the proper notes. Most guitar type instruments have fixed bridges, including basses and ukuleles.

Fixture

A fixture is another name for a jig, or a setup that helps accomplish some woodworking task easier than without it. See Jig for more information.

Flame Grain

This word is often times used interchangeably with figured or fiddle back, but it refers to a pattern of figure in Maple most of the time. It is a pattern that is familiar to anyone who has seen the back of a violin, where there are alternating stripes of lighter and darker wood, caused by the wood grain changing directions. Very highly flamed pieces are extremely rare, and fetch a correspondingly high price, where less flamed pieces are more common and are priced less.

Flat Sawn

A method of sawing lumber from a tree where the annual rings run horizontally when viewed from the end of the board. This is the most efficient way of cutting the largest amount of wood from a tree, with the least amount of waste. The saw is positioned at one end of the log, and it is ran through over and over making several slabs, and then each one of those is cut into pieces of a certain width.

Flat Top Guitar

Any guitar with a non-carved top can be called a flat top guitar. Most acoustic guitars do have a slight dome to the top, however this is still considered a flat top, since the top itself was not carved out of a thicker blank. Most if not all steel string western style acoustic guitars are going to be flat topped guitars.

Flex Shaft

Some rotary tools have an accessory that adds a flexible shaft to the tool, which allows the user to get into tighter places that the rotary tool may be too big to fit. It also allows the bit to be used more like holding a

pencil rather than a large tool. These are nice for inlay work when teamed up with a router base, or can be operated in the hand for fine carving.

Floor Standing

A power tool that is too large for bench top use, and requires space on the floor is called a floor standing machine or tool. Most table saws and jointers are floor standing, as they have their own bases, and do not require a bench or table to sit upon. The term is also used simply to describe larger pieces of woodworking equipment.

Flush Cut Saw

This is a thin metal saw with a flexible blade and a kerf that is the same width as the rest of the blade. The tool is designed to be bent flat against the surface of the wood, and cut off the excess from an inlay. These are often used when round fret markers are installed, and can be useful in removing the bulk of the waste material very quickly. The reason they do not have set teeth is because they are designed not to scratch the surface they are cutting against, which would cause more work in the long run.

Flush Trim Bit

Used in the router, a flush trim bit is a straight cutter with a bearing at the end, that is the same diameter as the cutter. This allows the router to be ran with the bearing following a profile, and the cutter will match whatever the router is ran against. When the plates are trimmed, a flush trim bit can be used. It is ran against the sides, and the cutter trims the overhang on the plates flush with the sides. They can also be used to duplicate pieces of wood by using the first piece as a pattern on a router table. The outside mold for the acoustic guitar is made this way.

Flute Bit

This is a common name for a straight cutting router bit. See Straight Bit for more information.

Foredom Tool

The Foredom tool is the premier rotary tool for delicate carving and high end inlay work. It is a motor that is suspended on a hook with a flexible shaft, where different bits are used to carve with. A router style

base can be used with the tool to make a professional inlaying setup. At its most basic level it is a rotary tool, however it is designed to be a very high end professional piece, and to give better results for fine inlay work.

Forstner Bit

A brand name for a counter bore bit that makes a hole with straight sides and a flat bottom. These can be found in many sizes, and go up to several inches in diameter. They make excellent bits for inlaying round fret markers, because they leave a very clean hole, and have a point in the center to ensure they go into the wood where they are supposed to. A set of Forstner bits ranging from 1/4" to 1" in increments of 1/8" will be very useful in the shop, and come in handy for a variety of tasks.

Fox Side Bender

The standard for guitar side bending jigs, and a revolution for people making guitars at home is the Fox side bender. This is a high end version of a side bending jig, which can come in several styles. See Side Bending Jig for more information.

French Curve

A French curve is a template used for drawing curved lines when making small drawings that require consistent curves. It can also be used to refer to the cabinet scraper that has the same shape, which is used to scrape many different complex curves in wood. It is shaped like a tear drop with an extra curl at the end, and almost any small radius can be found somewhere on its edge.

Fret

A fret or frets are the locations on the neck of the guitar where a string is pressed to make a certain note. These are in mathematically planned positions, and they essentially shorten the string length to allow it to make a certain pitch when played. This term is also used for the actual wire piece that is used on the neck, which is where the string becomes terminated against when fretted.

Fret Bender

A small tool with three wheels that straight pieces of fret wire are fed into, and they exit the tool as curved pieces. The amount and tightness of the curve can be determined by altering the position of an adjustable wheel. These can easily be made in the shop, and they make bending the fret wire to a constant radius before fretting into an easy task. A slight over bend is always needed before fretting, and the fret bender makes this a very quick and easy process.

Fret Beveling File

A file in a housing that is ran along the edge of the fretboard, which bevels the fret ends to a specific angle, usually 30 degrees. This tool can be bought or made, and it is simply a metal file inserted into a wooden block at a 30 degree angle. The whole unit is ran back and forth, shaping the ends of the frets into a nice and uniform bevel.

Fret Crown

The crown of the fret is the piece that is visible when installed on the fretboard. It is the part of the fret wire that is pressed against when a string is fretted, and sets the length of the string for a certain pitch. Fret crowns come in several heights and thicknesses, and can vary from instrument type to instrument type. Acoustic guitars tend to have small to medium crowns, and electric guitars tend to have fatter and larger crowns. The size does not matter as much, though bigger fret wire can be filed and dressed more times before needing to be replaced.

Fret Crowning

Using a special metal file that puts a smooth round profile on the fret is called crowning the frets or fret crowning. When the frets are leveled, they end up being sanded flat on the top. Crowning the frets puts the radius back on them, so the contact point for the string is not a large flat area that can buzz. The crown makes the contact point for the string very small again, and makes the frets look better too.

Fret Dots

Small round markers that are inlaid into the frets to mark the position being played. These are commonly made from Abalone, Mother of Pearl, wood, or plastic. Holes are drilled into the fretboard in certain

locations, and the small discs are glued into the holes. Once the glue dries they are sanded level. Typically the dots are on frets three, five, seven, nine, twelve, fifteen, seventeen, nineteen, twenty one, twenty three, and twenty four.

Fret Dressing

This refers to the act of filing, leveling, and crowning frets, so the neck plays well and the frets are all sized correctly. The process requires several special tools, and a few different operations, but is important in making extremely flat and well playing necks. It also makes the frets look much nicer, especially after having been sanded flat in some areas.

Fret File

This is the name given to any file that is specifically made for fret work, though normally associated with the fret crowning file. These are metal files that are designed to help shape and profile the frets while they are on the fretboard.

Fret Leveling File

A flat metal file that is around an inch wide and at least a few inches long. It is used to level out the frets by being dragged along their surfaces, removing metal from the high spots. These can be as simple as a smooth metal file, or they can be glued with epoxy onto wooden handles that make them easier to work with. They come in several lengths, with the longer ones being able to hit more frets at once.

Fret Markers

Any inlaid piece that is placed on certain frets to aid in playing can be called a fret marker. These are also called position markers, and are normally on specific frets which make it easier to play the instrument. These can be as simple as small dots inlaid with a drill, or custom cut abalone pieces, each one carefully inlaid.

Fret Nipper

A set of metal cutters that are specifically ground down to make a fine cut very close to the edge of the fretboard. They are used to trim the ends of the fret wire that hang out passed the edge of the fretboard after

they are hammered into place. The tool is useful because it can get closer to the board than regular nippers, meaning less filing has to be done after the bulk of the fret ends have been clipped off. Less filing means less chance for damaging the fretboard accidentally with the file.

Fret Press

A special caul that can be chucked in a drill press or arbor press, and used to seat frets with pressure. These can be made or purchased from a guitar supply house, and they turn a drill press into a fret seating press that can handle several different radii by simply changing inserts.

Fret Saw

A specially made saw where the blade and kerf are a certain width, which create a tight fit for the fret tangs as they are hammered into place. These saws are typically called gents saws or back saws, and they are small in size. They will need to be purchased especially for the task of fretting, and should be bought from the same place that sells the fret wire being used. When both are bought from the same place, they are matched well, and the saw will create the perfect size slot for the fret wire.

Fret Seating

The act of hammering or pressing a fret into position, causing it to go in as far as it can, where the bottom of the crown makes contact with the fretboard. This can be done with a caul and a press, or it can be done with a hammer. Seating the fret means simply to drive it into the slot completely and correctly.

Fret Seating Caul

A curved piece of wood, plastic, or metal that is used to assist in hammering the frets in evenly, and without damage to the fretboard. The radius on the caul is made to match the radius on the fretboard, and it will seat an entire fret at one time, rather than hammering in one area at a time. This results in more even and better fretting, with less damage to the wood.

Fret Tang

The part of the fret that is hammered into the fretboard when fretting. This thin piece has small bumps on it that help it dig into the fretboard and hold in place when hammered in. These can also be glued in

the slots as well as pressure fit, to ensure they do not come loose at any time in the near future.

Fret Wire

When buying material to fret a guitar, the frets themselves comes as one long piece of metal called a fret wire. The fret wire is then cut into individual pieces called frets, which are hammered into the fretboard. The wire comes in bulk packaging at a discount from many suppliers, and either comes straight or already bent. Either type will work, and they come in a few different thicknesses and widths depending on the type of guitar being made.

Fretboard

The piece of wood that the frets are hammered into is called the fretboard, and it is glued to the neck. This is different than a fingerboard, which does not have any frets at all. Fretboards can come in many species, though Rosewood and Ebony are the most common two choices. The frets are placed on these boards in carefully planned locations, and the board is fixed to the neck, making a playable surface.

Fretboard Overhang

The portion of the fretboard that sticks out over the body of the guitar, and is trimmed to meet the soundhole area. Sometimes this piece is allowed to float over the body, and other times it is clamped down and glued to the soundboard. The end of the fretboard overhang can be cut to match the soundhole, or to contrast it.

Fretless

Often associated with bass guitars more than steel string guitars, an instrument that has no fret wire installed on the fingerboard is called a fretless instrument. There can be markers placed on the board to show the locations of the notes, however there are no actual metal bars that the strings are pressed against. The advantage to a fretless instrument is that minute changes in pitch can be made by rolling the fretting finger forwards or backwards. An infinite number of tones can be played on a fretless instrument, where a fretted instrument can only play a certain number without bending the strings.

Fretting

The act of installing frets on the fretboard of a guitar. This can be done with a hammer or with a caul and pressure.

Fretting Hammer

A special hammer that has plastic faces designed to not mar the surface of the fretboard if accidentally struck. Sometimes the faces are interchangeable, and the hammer is typically small and light weight. Fretting does not require a ten ton hammer, so these are normally delicate and only to be used for fretting an instrument.

Front Vise

A vise that is found on the front of a wooden work bench with a large wooden face and a large wooden crank. These are common on old fashioned work benches, and they are extremely versatile and helpful in guitar making. Very large pieces can be clamped in the vise and worked on with both hands, and small pieces can still be held with it as well. These can be retro-fitted to an existing work bench with a kit, and they are easy to install. There are also smaller models available that can hold individual parts as they are worked on.

-G-

Gear Ratio

A term used when looking at tuning machines, the gear ratio is the amount of turns of the knob it takes in order to rotate the shaft one time. Most tuners are going to be in the 16:1 region, with higher end tuners having a higher gear ratio and inexpensive tuners having a lower ratio. There are far more things to consider when choosing tuners than gear ratio alone, and a lower gear ratio does not mean that the tuners are necessarily of poorer quality. A higher gear ratio means that fine tuning the pitch of the string is much easier, because the turning of the knob changes the pitch much more slowly.

Glazing

When a coat of stain is added over a clear sealer coat, and then trapped beneath another clear layer, this is called glazing. The clear layer on the bottom prevents the stain from penetrating into the wood, which allows it to be spread around and removed from certain areas if desired. Once the stain dries, another clear coat is added to trap the stain, and the look is locked in. More layers of clear can be added on top of it, or another glaze layer can be added for more effect.

Gloss Level

A common term used interchangeably with the term sheen, or sheen level. See Sheen for more information.

Glue

A generic term for a substance that can be spread between two materials and it will hold them together tightly for a long time. Glues can come in many different varieties depending on the application, and they should only be used for their intended purpose. Wood glue is the type that is most often just referred to as glue, simply because it is the most commonly used glue in guitar making.

Glue Brush

A special brush that is used to apply glue from a reservoir of some type, most often used with hot hide glue. These brushes cannot have any metal parts that contact the glue mixture, so they are often made with just a wooden handle and fibers glued to one end. Care for the brush well and rinse it out after each use and it will last a very long time. Glue brushes for AR glue are typically made with silicone bristles that make washing them very easy.

Glue Injector

A small syringe looking apparatus that is meant to be filled with glue and used to apply it in a very hard to reach area. This is also called a glue syringe, and is used to inject glue into cracks, creaking joints, and anywhere else a regular glue nozzle would have a hard time reaching. These need to be cleaned thoroughly after use, or capped and kept from drying out. Once glue dries inside they are worthless, and a new one will need to be purchased.

Glue Joint

Any joining of two pieces of wood with glue only is called a glue joint. As soon as something else is added like a biscuit, dowel, or dovetail, it is not called a glue joint anymore, even though it still uses glue. Glue joints that are well constructed are very strong, even stronger than the wood itself. In fact, when a piece of wood is flexed over the glue joint, the piece will actually break to one side of the joint instead of directly on it. Glue is not something to be underestimated, because it is strong, easy to use, and makes joints that last a very long time.

Glue Line

When two pieces of wood are glued together, no matter how well they are jointed and clamped, there will always be a very fine glue line that is visible afterwards. This is an extremely fine and sometimes very hard to see line that follows the edges of the pieces that were glued, and normally it is a cream color which matches the glue. Efforts to minimize the glue line are important in guitar making, because a poor looking joint will show a much larger line. Well fitting surfaces, good clamping pressure, and spreading glue well inside the joint, all improve the appearance of the glue line, and make it less visible.

Glue Pot

Often used with hot hide glue, the glue pot is a small double boiler that heats up water to a certain temperature, that in turn heats up a small jar or bottle of glue to that same temperature. These can be purchased online, or they can be made from several store grocery store items like crock pots, baby bottle warmers, and tea water boilers.

Go Deck

Also called a go-bar beck, this is a special type of clamping system that uses dowels of a certain length inside of a box that is a little shorter than the dowels are. The piece to be clamped (usually a guitar top and braces) is placed in the bottom of the box, and the bars are bent and placed inside as well. They exert pressure on the top and the bottom of the box, pressing the braces against the top while the glue dries. They are often used with a curved dish on the bottom causing the wooden guitar top to conform to the same shape. These are inexpensive to make, and dowels can be used for the sticks. If purchased, fiberglass rods are also available, and apply a more consistent pressure.

Goncalo Alves

A Central American to South American hardwood that is very dense, and has streaks running through it in several shades of brown. These streaks often alternate, giving the wood a nice striped look, which makes a very striking guitar. The ultra dense and heavy wood helps make necks with more mass and more sustain, as well as making backs and sides that are amazing to look at. Easy to bend, and easy to machine, Goncalo Alves is a great guitar making wood.

Gouge

A metal tool that looks like a chisel, except the cutting edge is rounded slightly rather than being a flat edge. Gouges are useful as carving tools for making arch top guitars and for carving arched solid body tops. They require sharpening and honing often in order to maintain a very sharp edge, but they will remove wood easily and cleanly. The radius at the cutting end and the distance between the two ends of the cutting edge are used to denote the size of the tool, one being an arbitrary number for the radius and the other being the size in millimeters. When buying gouges,

they will not be cheap, and a method of sharpening them should also be purchased at the same time.

Grading (Of Wood)

Wood is separated into different grades based on how well they look, the cut, the number of defects, and the figure. These grading levels are different from each grader to the next, and generally reflect the visual quality of the wood rather than the acoustic quality. There is no way of knowing for sure that one board will sound better than another, given that they are similar in every other way, so grading simply means higher grades will either look better or have better figure than a medium or lower grade.

Grain

The annual lines and the colors and patterns they produce in wood is called grain. Some pieces have very intense and interesting looking grain, while others have bland and unexciting grain. Very interesting grain is rare in wood, and can cause the piece to sell for as much as ten times what the average piece would sell for or more. The wood is not necessarily any better acoustically or structurally, but the beauty is the rarity, which causes the price increase. This can also be used to refer to the individual wood fibers themselves, and the direction they run. When working a piece of wood, it is best to work with the direction of these fibers rather than against them, which can cause problems like splitting or tear out.

Grain Pattern

The pattern in which the grain takes, which is sometimes very common and even named. Flame, quilt, and curly are all grain patterns. These should be familiar to anyone who has worked with Maple before, and are commonly available.

Green Wood

Any wood that is freshly cut, or still containing a high moisture content, is referred to as green wood. This kind of wet wood should be avoided for use in guitar making until it has been dried well and seasoned. Wet wood will shrink as it dries, causing cracks, warping, and bows. This movement will cause problems with glue joints, and can cause joint failure to occur in the finished guitar weeks or months down the line.

Grinder

A power tool that sits on the bench and has two rotating wheels of different grits that are designed to abrade metal. These are most often used to sharpen tools, or smooth out burrs on a piece of metal. The standard grinders spin far too fast for sharpening work, but can be handy should any metal grinding need to be done on any tools. The wheels are changeable, and come in a variety of grit levels and qualities.

Grit

The unit of measurement in expressing how coarse or fine a piece of sandpaper is. A coarse grit paper will have larger particles on it, removing more wood than finer grit paper with smaller particles. The higher the number on the sandpaper the finer the grit, meaning that 220 grit is finer than 80, and 1200 is finer than 400. The expression moving through the grits is used to sum up the long process of using finer and finer paper to achieve a smooth surface on a piece of wood. The particles themselves can also be made of different materials depending on what type of sanding will be done.

Growth Rings

Also called annual rings, these are the circles that form around a tree that every child in school has counted to determine the age of a tree in their science class. These are light and dark, and come in many colors depending on the wood species and when in the season the ring was formed. Looking at the growth rings, the type of cut (flat sawn or quarter sawn) can be determined.

Guitar

If this word required looking up in the glossary, this book may not be for you.

Guitar Humidifier

Often placed inside the soundhole of an acoustic guitar, this is a small plastic unit that contains a chemical that stores water, and increases the humidity inside the guitar. These units prolong the life of a guitar by keeping the inside from drying too much, which can cause cracks. Once the unit runs out of water, more can be added which will recharge it. These

come in a few different types, though in the end they all do the same thing essentially.

Guitar Kit

A good way to try out guitar making without having to buy as many tools, is to start out with a guitar kit. These are sets of materials and hardware that are put together and sold as a unit. Most of the harder work has been done already, yet there is still plenty of work to be done to make a proper sounding acoustic guitar. This is a good first experience in guitar making, and a good quality kit will make an excellent guitar. If the desire to make a guitar from scratch still burns intensely after the kit is made, then it is safe to start buying big expensive power tools.

-H-

Hacksaw

A saw with a metal spine and single handle, most often used to cut metal. A special blade is fitted to the saw that makes it work well for metal cutting, and is necessary for constructing truss rods. Any time a piece of metal needs to be cut, a hack saw makes the process easy and quick. They can cut metal rods to length, as well as cut truss rod blocks from a thick metal bar. When making inlays from spent cartridge shells, the hack saw is the best choice for cutting the bottoms off the cases.

Hand Plane

An edged tool consisting of a blade with a housing, that can be adjusted for depth of cut and the blade removed for sharpening when needed. The housing holds the blade in position, sticking out slightly on the middle of the sole, or bottom. The bottom is completely flat, and it is pushed along the surface so the blade can remove wood. There are many types of planes for many different woodworking processes, and having a couple planes in the shop can be very useful. As with any edged tool, they will need to be taken care of and sharpened to be effective, and with practice they become easier to use. At least a small block plane should be in every shop, because it can perform many tasks that take too long for sandpaper or scrapers alone.

Hand Saw

Any non-powered saw that is used to cut wood can be called a hand saw. The most commonly used hand saws for guitar makers are the fret saw, hack saw, and back saw. A hand saw exists that can do any of the operations that a machine saw can, though it will take a little longer and require a little more energy. Hand saws are much quieter though, and help to connect us to the woodworking traditions of the past. Sometimes it is nice to do things the old fashioned way, which is often times simpler and quieter. Machines are great time savers, but there are occasions where it is not always about time.

Hand Screw Clamp

This clamp has two long wooden jaws that have two threaded shafts running through them. The threaded shafts have handles that can be turned to open and close the clamp. These are very common older style clamps, and they are fairly versatile. For guitar making use however, they can be a little big and bulky, and most makers prefer cam clamps because they are lighter and easier to position.

Hardware

Any small pieces that are attached to the guitar after the woodworking phase has been, completed can be called hardware. This can be one item or a collection of items, and includes the tuners, nut, saddle, pins, and any electric components.

Hardwood (Hard Wood)

The term hardwood actually has nothing to do with the density of a piece of wood, rather it is used to describe any wood species that has large broad leaves. Proof to this point is that Balsa wood, the softest and lightest wood on earth, is technically considered a hard wood. When the term is used, it has more to do with using wood other than Pine, which is a soft wood. The densities of hard wood vary greatly, though many of those found in special hardwood stores are indeed dense and very good for making guitars with.

Head Block

Inside the guitar body, the block of wood at the top where the neck attaches is called the head block. It completely fills the gap between the plates, is 3"-4" wide, and usually 4/4 thick. Head blocks are made from Mahogany typically, though they can be made of any species that is suitable for being made into guitar sides. Some factories cut corners and make their head blocks out of plywood, and though it does not affect the sound, it does make the guitars look low end. It is good practice to bevel the side edges of the head block as well as the tail block to reduce their weight in the guitar. This can be done easily on the band saw or the table saw with a push stick.

Headstock (Head Stock)

The part of the guitar neck that is above the nut, and where the tuning machines are attached. The headstock can be shaped many different ways depending on the maker as well as the style of tuners being used. Most acoustics use symmetrical shapes, which work well with three tuners being on each side of the head. The headstock is a great place for expression by making a custom shape, and doing some inlay work. Guitar makers mark their brand name on their headstocks as a way for the customer to easily identify them.

Headstock Angle

When viewed from the side, the headstock pitches backwards a little bit, usually around fifteen degrees. This angle is called the headstock angle, and it serves to terminate the strings against the nut, which sets their playing length. Too little angle and the strings will not play as well, and too high an angle and they will not pull through the nut easily. Keeping the headstock angle somewhere in the fifteen degree region is a safe bet, and should not be deviated from by more than a few degrees either way.

Heart Wood

The inner part of the tree, where the wood is dead and inactive, heart wood comprises a majority of the tree. Heart wood provides structure and strength to the outer portion of the tree called the sap wood, which is the part of the tree that is living.

Heat Gun

An electric tool that looks like a drill and blows super heated air. There are sometimes different heat settings that can be chosen, and the temperature can get into the hundreds of degrees, hot enough to steam water. Normally used for paint and finish removal, a heat gun can actually be used to make a simple bending iron by directing the air flow through a metal pipe. The air heats the pipe, and wood can then be bent with it.

Heating Blanket

These are very thin electric heaters that are meant to be sandwiched between metal strips and used to bend guitar sides with. These heating blankets come in several sizes depending on the instrument being made, and they can heat up to over 500 degrees fairly quickly. A sandwich

is made with the blanket next to the piece of wood, and a piece of thin metal on the top and bottom. The blanket is turned on, and the whole setup is clamped to a bending form in the shape of a guitar side. Once the clamping is done, the blanket is turned off, and the whole setup allowed to cool. After cooling, the sides are removed.

Heel

The heel of the guitar is located at the base of the neck, where it attaches to the body. The dovetail or mortise and tenon is cut from this portion of the neck, and it covers the joint between the two sides. These can be very simple and smooth, or they can be carved with a pattern or other details. The heel spreads out the force of the strings more than if the neck were the same thickness all the way to the body.

Heel Cap

On the heel of the acoustic guitar, a small contrasting piece of wood is often added to match the binding. This small piece is called the heel cap, and it can be very simple or much more elaborate. A layer of three pieces of wood can be used instead of one piece, and it will give a little flair to an often underappreciated part of the guitar. A very wild and interesting piece of wood that is not even used anywhere on the rest of the guitar can also be used to add some interest to the neck. Padauk is a great candidate for an interesting heel cap, and is it bright red and really attracts attention. Ebony or Purple Heart are two more eye catching choices that make excellent heel caps.

Herringbone Purfling

A popular style of guitar purfling for centuries, herringbone looks like small arrow fletching running the entire length of the strip. These strips are long and skinny, and designed to be inlaid into the top of the guitar next to the binding. The herringbone pattern is a classic, and gives a guitar a very nice traditional look and feel. Herringbone can be used around the soundhole as part of the rosette, or it can be used as the back stripe. Herringbone purfling comes in several sizes, in which the pattern is either finer or more bold.

Hide Glue

A glue that is made from the hides and connective tissues of animals is called hide glue. This is the oldest known form of glue, and has history as far as 6000 years ago. A solid when dry and at room temperature, hide glue crystals are mixed with water and heated to form a thin brown runny mixture. It is brushed onto two mating surfaces and pressed together with a clamp. The water in the glue evaporates, and the bond is set.

High Speed Steel

A higher quality of steel used to make edged tools and cutters. Not as strong as carbide, high speed steel is a step above standard steel in strength and performance. The better the steel, the less time will have to be spent sharpening the tool, and the longer it will cut accurately. Retaining the edge longer means less time spent honing and sharpening, and more time spent making guitars.

Hobby Knife

A triangle shaped razor knife that is held with a thin pen shaped handle. The hobby knife has many different blades that can be used with the same handle, and they can be easily removed and changed after they become dull. These are great for making delicate cuts, marking around inlays, and trimming the fuzz left behind after using the router.

Hold Down

A type of clamp that is fixed to a flat surface and is actuated by flipping a lever, which holds something down against the same surface. These are useful for mass production, where several stages are set up at different areas of the shop, where the same step will be performed at each stage. An area where the top braces will be carved can have a couple hold downs to clamp the guitar top against the bench while carving. A neck carving station can have a couple more hold downs that hold the neck in place while the profile is carved. Hold downs are useful to have around, and some of them even adjust to the thickness of the piece automatically. They are also great on the drill press for a quick extra set of hands to hold a piece against the table top.

Hole Saw

Contrary to the name, this is a drill accessory that uses a large round saw blade attached to an arbor, to cut a wide hole through a piece of wood. They come in many sizes, and are often used when a large enough Forstner bit is not available. These typically come as a set or individually, and one saw at a time can attach to the arbor. These are useful for cutting the wheels for making a fret bender in the shop, but they can also be used to cut holes for clamp pads to secure jigs to the workbench.

Honing

Honing is a step past sharpening where extremely fine stones, compounds, or other methods are used to make the edge of the item being honed incredibly sharp. Honing will make a mirror finish on the edge typically, because the grit is so fine, and the amount of material being removed is so little. A well honed tool will work far better than one which has simply been sharpened.

Honing Compound

A very fine abrasive that is meant to be applied to a piece of leather for use as a strop. Honing compounds come in varying grits, all of them being on the very fine side. These are applied to a leather strop, and the tool is worked back and forth until the edge has been polished and becomes razor sharp.

Honing Guide

A small metal chassis with a wheel, and a method of holding an edged tool is called a honing guide. It is designed for the tool being honed, and is meant to make it easier to perform the task while keeping the tool properly held. These guides are especially helpful when sharpening and honing chisels and plane irons, because keeping them at the proper angle while moving them across the stone is very important. A good honing guide will make sharpening easier, and increase the chances that it will be done as often as it should.

Hook Tooth Blade

A saw blade with teeth that are angled downward towards the material being cut, and having deep gullets that allow more room for waste material to be removed. These blades tend to cut more aggressively, as well

as remove wood by pulling it off in curls due to the blade shape. Hook tooth blades do well with harder woods as the teeth are making more of a cutting action to remove wood.

Horizontal

Something that goes left to right, or in the same orientation as the horizon is considered to be horizontal. Most often used as a means of explaining placement in a diagram, horizontal would be perpendicular to vertical. The words printed on this page are done so horizontally.

Hot Hide Glue

Another name for hide glue, See Hide Glue for more information.

Humbucker

This is the common name for a type of electric guitar pickup that uses two pickup coils, wired with opposite polarities, that end up canceling out the hum that each one produces individually. On the guitar, they just look like two single coil pickups right next to one another. These kinds of pickups do not have a hum that can be heard when the playing stops, since the two coils are close enough to cancel each other out. Found more on electric guitars than acoustic guitars, these are the standard for rock guitars.

Hygrometer

A device used to measure the level of humidity in a certain area. These are small units with a dial and a scale to display how much humidity is in the room. Having a hygrometer in the shop is a good way of checking how much humidity is in the air, and make adjustments to the humidifier/dehumidifier system if necessary. If the shop has central air conditioning, it is a good chance that the humidity is fairly low inside, which will not require as much worrying over as an outdoor shop.

-I-

Imperial System

Another name for the English system of measurement, See English System for more information.

In Feed

The portion of the machine where the boards or wood are fed towards the blade or cutter is called the in feed. These are commonly on thickness planers and drum sanders, and are built right onto the machine in most cases. These tables need to be flush and even with the base of the machine in order for the exiting boards to be accurate and even.

In Line Tuners

Inline tuners are those that have all six tuning machines on one side of the peg head, making them sit in a straight line. Electric guitars most often have in line tuners, however acoustics can have them once in a while. These require a non-symmetrical head where all the tuners can be installed on one side, which can be an interesting design challenge for a guitar maker. Most acoustics have symmetrical headstocks, which lends itself more to tuners that are three on a side.

In Tune

An instrument is referred to as being in tune when the strings are tensioned properly to produce a common set of notes. On the guitar, these would be E,A,D,G,B, and e from the lowest to the highest strings.

Inlace

Inlace is the name of a product that is a mix of epoxy and different colored stones which is poured into a cavity and sanded flush when dry. The epoxy and stone forms a solid inlay, which is available in a variety of colors and mixtures. Custom mixtures can also be made by combining different solid materials into the epoxy, adding the hardener, and pouring into the inlay cavity. Inlace kits are an easy way to accomplish a complex inlay because the only crucial part is getting the cavity created

with a router or dremel correctly. Once this part is done, the epoxy inlay will fill all gaps and end up as a solid inlay.

Inlay

When a piece of wood, metal, shell, or other material is set flush into a piece of wood for decoration and embellishment, it is called an inlay. The piece must be set into the surface by making a cavity with a rotary tool, router, or chisels in order for it to be called an inlay. Gluing pieces onto the surface of the wood is called Marquetry, which is different than inlaying. The piece to be inlaid is scribed around, tracing the outline onto the piece of wood it will be inlaid into. A rotary tool or router is used to clear out the material inside the lines, making room for the inlay. Epoxy or super glue is added to the cavity, and the piece is pressed into position, leaving it a little above the surface of the wood. After the glue dries, the inlay is sanded flush, leaving a very close fit. More pieces are added the same way, and the final result will be a nice looking inlay.

Inlay Kit

Sold as a set, the inlay kit contains a bushing for the router, retaining ring, brass ring, aligning pin, and a carbide cutter bit. The kit makes it possible to use a template to route a precision inlay cavity and inlay piece that fit perfectly together. The kit is only useful for basic shapes and cannot do inlays with tight curves, however for basic shapes and larger pieces it makes inlaying much easier and more accurate. The most common use for this kit is with electric guitar making, and it is used to make a custom scratch plate for the rear of the guitar that sits flush with the surface. This has a far more professional and custom look than screwing the cover on top of the instrument. A cavity cover that is inlaid flush to the surface is the standard for fine electric guitars, and is easily made with this kit.

Inlay Tiles

Specially made wooden pieces that are cut from a mosaic log are called inlay tiles. Several long and thin pieces of wood are arranged in a pattern when viewed from the end. There may be 50-100 sticks in one of these mosaics, which are planned out on paper before being glued together. Once the glue dries, tiles are cut off the end of the log, and laid flat to view the pattern. These are used on guitar rosettes and inlaid into a circle, or they

are beveled slightly and used by themselves. Simple mosaic logs can be made from rosette making sticks and used as fretboard markers as well. Alternating the side of tile that faces up, repeating patterns of mirror matching pieces can be made, which is a very complex look.

Input Jack

On electrics and acoustic electrics, this is the small metal opening that the guitar cable plugs into, transferring the electronic signal to the amplifier. On acoustic guitars the jack is often hid in the end pin, though this can also be on the side as well. These are sized for a quarter inch mono or stereo cable, and hold the cable in place when connected with pressure from a small clip.

Insert (Table Saw/Router Table)

The insert is the small piece of metal or plastic that is near the blade or bit, which can be removed or changed as needed to suit larger bits or different blades. It is a visual indicator for where not to allow the fingers to move, and is the place in which the blade or bit can come through the table top. Inserts are sold for different proposes and in different sizes, depending on what type of work is being done. Table saws have zero clearance inserts which allow very small pieces to get right next to the blade without falling through the saw. Router tables have larger and smaller diameter discs that are changed as different diameter bits are used. Discs with smaller holes are used with smaller bits, while larger cutters will need a larger opening.

Inside Cut

An inside cut is a special kind of saw cut where there are no entrance or exit cuts made, and a piece of wood is cut and removed from the center of a board. This can be accomplished with a jig saw and a drill, first drilling a hole for the saw blade and then cutting out the shape. A scroll saw can also be used, with the blade threaded through a drill hole and the piece being cut out. A coping saw is a non-powered method of making an inside cut. A hole is drilled inside the shape to be cut out, and the coping saw blade is threaded through before cutting out the piece.

Inside Mold

A wooden form that is shaped like the guitar, and the instrument is built around, is called an inside mold. This is the opposite of the outside mold, where the instrument is built inside the mold. An inside mold usually has areas where the head and tail blocks are temporarily glued to the form, and then the sides are bent and glued to the blocks. The top or the back can be glued in place while the form is still inside the guitar body, however it is removed before gluing on the other side. This style of mold is seen less with guitars and more with classical instruments like violins and cellos.

Inspection Mirror

This can be a single mirror on a telescopic handle, or a long thin piece of glass mirror that can be inserted into the soundhole to help see the soundboard. These are used any time there needs to be a repair inside the guitar, or something on the underside of the soundboard needs to be seen. They are often used to check for a makers mark or signature on the soundboard, as well as for finding and repairing failing braces. A small circular mirror with a handle and telescopic arm is very useful for repair work, and can help make it easier to see inside the instrument.

Interlocking grain

When the grain of a piece of wood alternates direction many times, this is called interlocking grain. It can be hard to plane and thickness interlocking grain, because it needs to be cut from many different directions to avoid ripping out grain. A hand plane is the best method for thinning this kind of wood, followed by a scraper to remove the plane marks. A piece with interlocking grain can be fed through the planer, though it will need to be stopped earlier than normal. This is so enough wood is left to sand down to final thickness and not have any missing grain. Run the board through the planer with very thin passes, otherwise it can be destroyed if it catches the blade against the grain. Once it is a little thicker than normal, stop the planing process and switch to a sanding or scraping process to go the rest of the way to final thickness.

Intonated Saddle

Intonated saddle is another term for compensated saddle. See Compensated Saddle for more information.

Intonation

The octave on a guitar is at the 12th fret, so the sound when the string is played open, and the sound when played at the 12th fret should be the exact same note, just one octave higher. This is not always the case however, and the guitar will sometimes need to have the saddle profiled a little differently to allow for proper intonation. When a guitar is intonated well, the octave and the open string are the exact same note, which means the guitar will play in tune over more of the fretboard, sounding better than if it was not intonated. There are special machines sold for this purpose that can identify small errors in intonation and help a luthier correct them. The instrument can also be taken to a guitar shop to be intonated, which will save money over buying a specialty machine for the process.

Iron

See Bending Iron or Plane Iron for more information on hand planes or side bending tools.

Ivoroid

This is a trade name for a cream colored plastic that is artificially grained to look like ivory, and sold by guitar suppliers. It is a wonderful alternative to killing elephants, and looks very good on a guitar. This product is available for bridge pins, end pins, and binding strips, and has an eye catching vintage cream look. Since they are plastic bindings, they can be glued in place without heat bending like wood requires. A little heat from a heat gun will make them more flexible if needed, but they will distort and melt very easily if heated too much. Go very slow when heating any plastic binding strips.

-J

Jack Plate

Most often used on electrics but also seen on acoustics, the jack plate is a square or oval metal plate that the input jack attaches to. This plate is screwed to the guitar, leaving a nicer look than the input jack alone would have. These come in chrome, black, or gold, or they can be made of wood to match any guitar build. A custom jack plate is a nice touch, especially when inlaid flush on the side and made from exotic wood.

Japanese Saw

Another name for a pull saw or a dozuki, See Dozuki for more information.

Jewelers Saw

A type of coping saw, this small saw is specifically made for use with extremely fine blades, and is most often used for cutting out inlays from shell. A jewelers saw with several fine blades are used with a sawing jig to cut out small pieces of abalone for inlaying into fretboards, headstocks, or anywhere else on the guitar. This saw has a super thin kerf, so the cuts are easier and the amount of material wasted by the saw is very low. Abalone is very expensive, so wasting as little as possible is a very good thing. Plus, with the kerf being so thin, the saw does not bite into the shell as much, reducing the chances of breaking it while cutting.

Jig

Any setup or fixture that makes it easier to perform a task in woodworking can be called a jig, and a jig can be made for almost anything. Jigs make it easier and more accurate to do certain aspects of a job, from making a cut to shaping a piece of wood. The point and purpose of a jig is to make the operation easier and make the pieces coming off the tool uniform. A saddle slotting jig makes routing the saddle slot very easy, and the resulting slot is far cleaner than anything that could be done freehand. A fret slotting jig makes sawing accurate fret slots quick and

accurate, saving hours over measuring and carefully sawing. Every minute spent making a jig will save an hour of time doing it without the jig.

Jigsaw

An electric saw that is hand held, and operates a thin blade by pulsing it up and down is a jig saw. This is a valuable tool for making an inside cut, and for cutting wood for a stacked neck. When a table saw is not available, a jig saw can do some of the operations better than doing it by hand. They are not meant for very thick stock, or very fine cutting, however as a versatile power tool they are often overlooked. A jig saw can work well at cutting out the top and back profiles if a band saw is not available, and it can also trim the sides to length. The jig saw can use many different blade types, cutting wood, plastic, and metal.

Jointer

A power tool with a rotating set of blades which straighten and flatten the edges of boards before they are glued together. The table top has a slot where the blades protrude, and can be adjusted for a deeper or shallower cut. The fence on the table top ensures the piece is held at a 90 degree angle, and several passes are made. With each pass, the higher spots are removed, slowly making the edge of the board flat and even. The edge can then be glued to another board without any gaps being in the joint. A jointer can be used for truing the joint between the plates when book matching, and can also be used to flatten boards before gluing. Not an inexpensive tool, however it is a time saving machine that can be very accurate if used well.

-K-

Kauri Wood

An interesting wood species to include on the acoustic guitar, Kauri wood is from 50,000 year old trees retrieved from a peat bog in New Zealand. The peat preserved the wood, preventing the natural decay and disintegration that would have occurred anywhere else. The wealth of the piece is in the fact that it is so old, and adding it to a guitar adds another dimension of interest and uniqueness. Pieces can be bought that are very large, though the smaller pieces are the best for adding into the guitar. Bridges, inlays, and peg head veneers can all be made from Kauri wood.

Kerf

The space left behind when a saw makes a cut is called the kerf. It is a name for the width of the cut, which is also used to describe the tooth set. The spacing of the teeth on a saw, or how they are offset from the center is called the set. It is also referred to as the kerf sometimes, because it is the teeth on the saw that determine how much wood will be removed by the blade itself. A wide kerf removes more wood than a narrow kerf, and should be factored into measurements when sawing multiple pieces from one board.

Kerfed Linings

Long strip with many cuts made almost all the way through it, causing it to become flexible. This strip is glued into the guitar to reinforce the joint between the sides and the plates, which is too small on its own. These strips have slots made with a saw that are usually around 1/4" apart, and they allow the long thin piece of wood to become bendable, which makes it easier to place and glue. Kerfing strips as they are also called, can be purchased from a guitar supply house or made in the shop. Making them does require patience and lots of repetitive sawing, however the price per strip is definitely worth making them in house.

Kerfing Clamp

A special small clamp that is used to hold the kerfing in place while the glue dries. These can be store bought spring clamps, or they can be made from clothespins and rubber bands. Many of them are needed, so the more economical alternative is definitely buying a couple packs of spring style clothespins and a bag of rubber bands. Dozens of these clamps are used to hold the kerfing strips to the sides of the guitar while the glue dries, and then the other side is done in the same way. Many clamps means strong and well distributed clamping pressure, which will help make a strong joint between the plates and the sides.

Kick Back

A danger in working with power tools is when the saw blade or router bit grabs a work piece and throws it, which is called kick back. This can happen in a split second and there is no way to react quick enough to prevent it. A table saw can catch a piece of wood and throw it at the user, causing injuries that can be really severe in some cases. Be sure to use all tools properly, and use the correct guides and push sticks to avoid having the hands near the blade should a piece become caught.

Kiln Dried

When pieces of freshly cut wood are placed in a large heated room that speeds up the drying process, this is called kiln drying. Kiln dried wood has been put through this speedy drying process, in order to get it to market quicker. There is nothing wrong with kiln dried wood, so long as it has been given some time to allow any cracks that might form to show themselves. Since kiln drying dries wood quickly, sometimes cracks and other problems can show up. As long as the wood has been on the store shelves for a couple weeks or more, it should be safe to use without worrying about cracks or problems from the faster drying.

Knob

Found more on electric guitars than acoustic guitars, the knobs are the small circular items that control the volume and tone through the electronics. These can be store bought or handmade, and they come in many shapes and sizes to suit any style of guitar being built. Some acoustic electric guitars have small knobs located on their modules that allow for making adjustments at the instrument instead of at the amplifier. Wooden

knobs can be made on the lathe to add a completely customized look to this area on electric guitars as well.

Knob Puller

A small tool that grabs under a guitar knob and helps pull it off the post without damaging the surface of the guitar. These are great for stubborn knobs, and remove them without fear of harming the finish. Normally, a knob can be removed with a thin knife if done carefully, but sometimes it cannot. A piece of plastic can be placed over the finish to protect it when prying with a knife, however always be careful not to damage the knob or the surface when pulling off a control knob.

Knot

A deformation on wood caused by a branch growing through the tree at that point, or some other anomaly that causes a dense area of harder wood to appear on the surface. Generally, wood that is knot free needs to be selected for guitar making. However, there are some pieces that have small knots which do not interfere with shaping the boards and would give the wood an interesting look. A piece with some small defects can be carefully examined and still used, however any large knots should be avoided completely when selecting wood for a guitar.

-L-

Lacquer

A clear finish that is most often sprayed, and is the standard in the industry for guitars. This is a very hard wearing and quick building finish. Each layer will build upon previous layers until a solid coating has been built up. This type of finish can be brushed on as well, though a special lacquer with more thinner is needed to do so. This type of lacquer eliminates the need for spray equipment, though will take longer in the end to even out by sanding. Lacquer can be sprayed from several cans if there is no spray equipment available, though it will require mastering a few practice boards before trying it out on the actual instrument.

Ladder Bracing

A system of guitar bracing normally used on the back plate where one or two vertical seam braces are used and several horizontal braces are also used. This gives the appearance of a ladder, which is how the name came about. This style of bracing is very common on the back of the guitar, and can even be found on the tops of older guitars. Ladder bracing was a predecessor to x-bracing, and the standard for hundreds of years. Some companies still offer new versions of vintage guitars that will have ladder bracing.

Laminate

Gluing several pieces of wood together to use as a blank for making something else is called laminating. When laminating wood, it is important to have flat joints that meet each other well, and good clamping pressure to ensure glue fills every part of the joint. Spread the glue with a roller to help get the pieces coated well before the glue starts to dry, then apply lots of clamping pressure as fast as possible to ensure a thin glue line. Laminating pieces of wood to make necks or bridges only takes a few more steps, but the results are beautiful.

Laminate Trimmer

Any small hand held router can be called a laminate trimmer. These are perfect size for guitar binding work, as they are powerful enough for the job but not so big that they are hard to move around. A laminate trimmer makes easy work of making the rabbets for binding strips, and they can also be great for inlay cavity routing.

Lapstrake Clamp

This style of clamp has been a standard in boat making forever, but has a valuable place in guitar making as well. This is a wooden clamp with two curved jaws that touch at each end, forming an oval looking shape. One side is hinged with leather or nylon webbing, and the other can be opened and closed. A threaded rod and a wing nut are in the middle of the clamp, and they are tightened to provide the force behind the clamp. These have the benefit of being able to be placed in hard to reach areas, and they have deep throats to reach over the edge of a board. The cost for making these is very low, and several can be made in the shop for the same cost as buying one or two. They do not clamp as hard as bar clamps or C clamps, however they apply plenty of pressure for making guitars.

Late Wood

When referring to the growing season of a tree, the wood that grows in the summer time and into the start of fall is called late wood. This is tighter and more dense than the early wood, which is formed to help transport water throughout the tree. The higher density late wood determines how dense a board will be, since the cells formed are smaller but have thicker cell walls. The late wood can be seen as the darker rings when examining the end grain of a board.

Latex Gloves

Thin disposable gloves made from latex, and sold in boxes with several dozen pair inside. A pair is used to safeguard the hands from finish chemicals as well as accidental staining, and thrown away afterwards. These are inexpensive, though they should not be used by anyone with a latex allergy.

Linings

Kerfing strips are sometimes referred to as linings, which is a violin making term for a similar piece. See Kerfed Linings for more information.

Linseed Oil

A natural finishing oil made by pressing the seeds from the flax plant. The oils are filtered and bottled for use by wood finishers. There are several types of linseed oil, but the one that will be most often used in guitar making is boiled linseed oil. The process actually has nothing to do with heating, rather metallic driers are added to help the oil dry quicker. The oil alone is called raw linseed oil, and does not dry very well. Sometimes, the oil never actually dries at all, leaving a damp feeling to the wood that never goes away. When in doubt, use boiled linseed oil for any guitar finishing, because it dries well enough to be handled and played within a couple weeks.

Liquid Hide Glue

Hide glue that has been chemically treated to allow it to remain a liquid at room temperature, is called liquid hide glue. Titebond is the most common maker of this glue, and it allows hide glue to be used without the fuss of using a double boiler, and mixing and measuring ingredients. There are some debates as to whether or not it will work the same as hot hide glue, and it does have a finite shelf life since it is in a liquid state. The differences pointed out by hot hide glue purists are fair, however it should not eliminate this product from use by guitar makers who want to use a more traditional material, without as much hassle as regular hide glue. There are certain chemicals that can be added to regular hot hide glue, which will extend the open time of the glue before it gels. This will allow more time for the woodworker to get joints in position before the glue becomes ineffective.

Locking Nut

Mostly seen on electrics but not completely foreign to acoustics is the locking nut. This metal nut has three blocks that are screwed to the base of the nut, holding the strings in place and preventing the tuners from loosening. This is a great way to keep a guitar in tune, though installation is a little more difficult. Mostly used when a floating tremolo is on the guitar,

locking nuts help the instrument stay in tune through very intense tremolo use.

Locking Tuners

Tuning machines that have a crank or set screw that is used to lock the tuners in place once the instrument has been tuned are called locking tuners. They are used to help keep the guitar in tune when playing for long sessions, and require loosening of the locking mechanism before tuning again. A nice addition that goes into the headstock the same way as regular tuning machines, however they make staying in tune much easier.

Lower Bout

The curved part of the guitar body that is closer to the bottom of the guitar is called the lower bout. It is measured at its widest point, which is how many manufacturers refer to their models. For example, a D-16 would be a dreadnought shaped guitar with a sixteen inch lower bout. The same would be true for an orchestra model fifteen. The lower bout is the most graceful of the three bends in the sides, having the largest radius and the fairest curve. Bending the lower bout is also much easier than bending the waist or upper bout, which make up the rest of the guitar body.

Lower Face Braces

The two long braces that extend from the bridge patch area across the lower bout of the guitar are called lower face braces. These braces affect the stiffness of the top plate in a big way, and their positioning can brighten or warm up the tone of a guitar. Lower face braces that are closer to parallel to the center seam on the top will stiffen the lower bout area, while those that are more perpendicular will loosen the area. Stiffer tops will be brighter, and looser tops will be warmer. These are also called lower tone bars, or just tone bars.

Luthier

The word luthier is literally translated as lute maker, however it is now used to describe anyone who builds stringed instruments. Acoustic guitar makers, violin makers, and banjo makers are all considered luthiers, making the term far more universal than it was originally. Though many who make instruments refer to themselves as either guitar makers, violin

makers, or mandolin makers, they would all still also be able to call themselves luthiers.

-M-

Machine Heads

Another name for tuning machines, or tuners, See Tuners for more information.

Machine Screw

Also called a bolt, a machine screw is an evenly threaded screw with a constant diameter and a flat point. They are meant to be used with a nut or threaded hole, and not driven directly into what they are fastening like wood screws are. Machine screws are useful in making jigs, as they can be piloted easily, and can also be removed easily. They come in several sizes, and each one has nuts and washers that are sized with it. A good size to have around is the 1/4-20 screw, in a 2" length. These are usually long enough for most jobs, and thick enough to hold up to years of abuse. Pick up a small box of 1/4-20 screws and some matching washers and nuts. They will be valuable for jig making. The 1/4 refers to the diameter of the screw, and the 20 refers to the number of threads per inch.

Mahogany

Mahogany is a name used for many species of hardwood that share similar characteristics and grow in tropical regions. Mahogany has a light brown to medium and sometimes dark brown color, and a pleasant smell when cut. The wood is not as dense as other guitar making woods, and imparts a warm tone to acoustic guitars. The standard wood for backs, sides, and guitar necks, Mahogany is relatively inexpensive and very easy to work with. The wood planes and cuts easily, and takes a finish really well, bringing out depth as well as shimmer and chatoyance. A whole guitar can be made form a large piece of mahogany, where every last wooden piece is made from the same board.

Mallet

A round or square wooden hammer type tool that is used to assist a chisel or gouge in removing wood. Not very large or heavy, a mallet is used more for bumping the butt end of the chisel to add a little more force for carving. They can be found in many different shapes, though a cylindrical or square shape are the two most common forms. They can be made in the shop out of any hard wood, and will last a very long time with normal use. When making a mallet, look for a very dense wood species like Purple Heart, Brazilian Cherry, or Lignum to make the head from. A heavy mallet head will carry more momentum with it, meaning it will not have to be swung as hard to still drive the chisel effectively.

Marking Gauge

Also called a mortise gauge, it is a wooden stem and a stock that is moveable, setting the distance from the edge that a pin or two will contact the face of a piece of wood, making a mark. These are often used for marking mortise and tenon joints, but can be used to mark for purfling and binding as well. Not as good of a choice as a purfling cutter, but it can be used to leave a guide line for the chisel to follow when making the rabbets by hand.

Marking Knife

A sharp hand held knife with one flat side that is used to mark lines on wood and score around inlay pieces. These are made by several companies and they come in right and left handed models. The difference being which side of the blade is flat and which is not. A good marking knife can make a mark that is as close to the inlay piece as possible, which a pencil cannot do. The blades on these can be sharpened easily, and one should last a lifetime.

Martin Scale Length

The Martin guitar company has had by far the largest effect on the acoustic guitar world, and rightfully so there are many standards that are attributed to the Martin guitar. The most commonly used scale length in the acoustic world is the Martin Standard Scale Length, which measures 25.340" from the nut to the saddle. This is a tried and true scale length, and should be used by any guitar maker who wants a reliable length to work with. The Martin company is also credited for standardizing several aspects

of the guitar, and their history is fascinating to read about. It is amazing to see how many innovations came from this one guitar maker.

Marquetry

A process of cutting out and gluing pieces of wood onto and next to one another to make a pattern or design. This is different than inlay, because it happens on the surface rather than in it. Marquetry can be used to enhance a guitar or to create a picture on the back of the guitar. A marquetry design can be used on the headstock as a makers mark, and adds an interesting element to the guitar. These designs are made with veneer mostly, cut to shape and glued next to each other to form a large picture, which can then be sealed in with finish to protect it. Marquetry is its own skill, however the basics of the process can be learned quickly.

Master Grade

In the wood grading system for guitars, master grade is typically the highest grade of wood that can be purchased. It is categorized as such due to several properties, including straightness of grain, evenness of coloring, and being free of defects. Of all the categories listed, none of them have anything to do with the sound that the board will produce when made into a guitar, it has everything to do with the look of the pieces. Master grade wood will not make a better sounding guitar than average grade wood, assuming they are from a similar tree and species. The maker has more to do with the sound of the guitar than any other factor.

MDF

Short for Medium Density Fiber Board, this is the new alternative to plywood for making jigs and shop fixtures. Sold in the same area of the store as plywood and construction wood, MDF is a mixture of wood dust and resin which is pressed into board shapes. Otherwise useless scraps of wood that are too small to be used in oriented strand board or plywood, are ground up into a powder and mixed with resin and hardener. The sludge is pressed into the shape of a board and allowed to cure. The cured piece is an even color, and is great for jigs and shop projects. Though there are manufacturing secrets associated with MDF, the above is the basic explanation of the process by which it is made.

Mechanical Bond

In finishing, when a layer of finish has a rough surface to dry onto, causing the two layers to lock together with mechanical force, this is called a mechanical bond. When applying finish to a surface, going any higher than 220 is counterproductive because the surface may be too smooth for finish to adhere to well. Also, scuffing between coats with some finishes improves the bond between the layers, like in the case of polyurethane. This is such a chemical resistant finish that it even has a hard time bonding to itself. Scuffing the first layer with steel wool or fine sandpaper roughs up the surface and gives the new layer something to stick to. This forms a mechanical bond between the layers, increasing the strength of the finish. It is not always necessary to create a mechanical bond between finish layers, as in the case of oils, however most varnishes benefit from a light scuffing between coats.

Metric (Metric System)

A system of measurement widely used in the UK and parts of the world other than the United States, where the different units are all divisible by ten or multiples of ten. This makes for a system that is much easier to learn because the next larger or smaller measurement involves either multiplying or dividing by ten in order to convert it. Ten millimeters is a centimeter, and one hundred centimeters is a meter. The math can be done simply by moving the decimal place, which makes the system far easier to learn than the English, or Imperial system.

Micarta

This is a brand name for a plastic compound that is a blend of several different compounds, which form a very dense piece of plastic. This super dense plastic is made into nuts and saddles that transfer energy very quickly, and damper next to nothing. Bone can be a problem with under saddle pickups because of the uneven density of a natural material. Micarta saddles will produce even transmission of vibrations across the entire piece, making it a better choice for use with under saddle pickups.

Micro Mesh

This is a trade name for a set of polishing sandpaper of several very fine grits. They are used in order of grit level to polish a piece of wood

or a finish to a shine. They are meant to be used on smaller pieces of wood like a bridge or bridge pin heads, and not as much on a whole guitar. The papers are not large enough and it would take several sets as well as several months of time to polish an entire guitar this way. For bridges however, this is a viable alternative to owning a buffing setup.

Mineral Oil

Another petroleum distillate, mineral oil is a thicker and more lubricating form of oil, and is used to lubricate the finishing rubber while French polishing wood. Denatured alcohol can evaporate through the mineral oil, which means that it does not interfere with the drying process of the shellac. It is used to lubricate the pad, which will begin to stick to the surface once enough shellac has been applied. Mineral oil can be found in the laxative section of the pharmacy, where it is still used by woodworkers from time to time, but for a different reason.

Mineral Spirits

Commonly referred to as paint thinner, which was true at the time when all paints and finishes were oil based, this is a petroleum distillate that is used to thin finishes as well as lubricate while rubbing out a finish. Do not confuse with mineral oil, which is used for completely different things. Mineral Spirits comes in tall rectangular cans at the hardware store, and one can will last a while if only used for sandpaper lubrication.

Miter Box

A wooden gutter shaped jig that has cutting guides sawn into the sides that help make 90 degree and 45 degree cuts with a hand saw. These are mostly wooden but are made of plastic as well, and have a very low cost when compared to a miter saw. They will normally come with saw guides for the two already mentioned angles, but can also come with guides for other commonly needed angles like 30 degrees and 60 degrees.

Miter Cut

A cross cut that is made on an angle other than 90 degrees, is called a miter cut. These kinds of cuts can be done on a miter saw, with a hand saw, or on a table saw. The most common angle at which a miter will

meet another miter, forming a joint, is 45 degrees. When the purfling on the sides is cut to meet the purfling at the end graft, the corners are cut on 45 degree angles, forming a miter joint.

Miter Gauge

The table saw and the band saw will typically have a track cut into the table top where the miter gauge will be used. This is an adjustable gauge with a small fence for cross cutting wood. The angle of the fence can be adjusted to any degree desired, which will make a miter cut. Any cross cut that is not made at 90 degrees can be called a miter cut, and the miter gauge assists in cutting evenly. To set the miter gauge back to 90 degrees, turn it upside down in the track and butt the fence against the edge of the table top with the adjustment screw loosened. The fence will adjust itself to be flat against the edge, making a 90 degree angle, at which point the adjustment screw can be tightened and the gauge flipped over again.

Miter Joint

Any joint in woodworking where two mitered pieces meet each other can be called a miter joint. The most common of these is when two boards with 45 degree miters meet and create a 90 degree corner. In guitar making, the end flash area has several miter joints where the purfling and the binding meet. This cleans up the area, and makes it nicer looking than butt joints, because more time and effort are needed to make miters.

Mobile Base

A specially made or purchased set of casters held in place by metal strips, which can support the weight of large shop machines. They allow a large floor standing tool to be moved around the shop easily, and kept out of the way when not in use. Mobile bases come in specific sizes for machines they will go under, and they also come in an adjustable universal version that can be built to suit almost any machine. The wheels lock or flip out of the way when the machine will be set down, and then they unlock when the machine needs to be moved again. Mobile bases can also be made from 2x4's and store bought casters, making any shop tool easily moveable.

Morse Taper

A drill chuck attaches to the arm of the drill press with a pressure fitting. This pressure fitting is a specially designed tapered hole and tapered insert on the end of the chuck. The Morse Taper is a specific sized taper that fits inside the opening on the tool, making a friction fit, which is strong enough to be safe and yet still easy to remove with a knock out tool or mallet. These are commonly found on drill presses and lathes, and the Morse taper size is only one of several taper standards that are produced.

Mortise Gauge

Also called a marking gauge, it is used for marking tenons. See Marking Gauge for more information.

Mosaic Rosette

A soundhole rosette made by using several hundred small sticks, perhaps even several thousand to make a design. These are assembled as long hollow cylinders and glued together in the shape and size of the rosette. A master rosette log can be several inches long, have an inside diameter of around 4" and an outside diameter of around 6". Once the whole unit dries, slices are cut off the end which are very thin, and can be inlaid into the surface of the guitar. One large rosette log can yield as many as several dozen rosettes, which are packaged individually and sold to guitar makers.

Mother Of Pearl

A white iridescent shell material that is used for inlaying. This can be harvested from several kinds of shells, and it is then cut into blanks that are sold to guitar makers and inlay artists. This material is mostly white, however there are many shades of white that make up the overall look. A classic inlay material that is available in several shapes and sizes to suit any inlaying need. It is normal to use all Abalone or all Mother Of Pearl to inlay a guitar, and not to mix the two colors.

Moveable Bridge

When a bridge is not fixed to the surface of the guitar and can be moved freely around the soundboard, this is called a moveable bridge.

Violins, arch top guitars, and cellos all have moveable bridges, which need to be placed correctly on the top while tuning the instrument.

Murphy's Oil Soap

Manufactured by the Palmolive company, this is a vegetable based concentrated soap that is used on cured finishes to lubricate sandpaper while rubbing out a finish. The oil soap is applied to the surface of the guitar once the finish has completely cured, and wet and dry sandpaper is then used to finely sand all over the guitar. The oil soap keeps the dust from clogging the sandpaper, causing corns, which just make the finish look even worse than before rubbing. Use a little bit, and add more if needed, because a little goes a long way.

-N-

Neck

The long skinny part of the guitar where the frets are located and is used to change the pitch of the instrument is called the neck. A well made neck is rigid enough to handle the tension of the strings and solid enough to withstand the constant stress. A strong wood like Mahogany, Walnut, or Rosewood is used to make the main part of the neck, which is reinforced with a truss rod to increase its strength. The neck is a great place for inlays and embellishments, and a focal point of the guitar.

Neck Joint

The place at which the neck and the body are connected is the neck joint. This connection needs to be very solid, so there is no loss of vibration though any damping from a poor joint. A weak joint will not be able to withstand the forces of the string tension, and will fail over time. Using a means of mechanical bonding as well as gluing will increase the strength of the joint as well as ensure that it is not a weak point on the guitar. This is a twofold approach to ensuring a very strong neck to body joint.

Neck Mortise

The neck mortise is the square slot that is carved into the head block of the body, where the tenon from the heel of the neck will be inserted. This will form a very strong joint, because there will be an increase in the amount of gluing surface over just a flat joint, and there will be wood shared between the two pieces in the tenon. The mortise and tenon is a very strong wood working joint, and it makes a very strong neck to body joint as well.

Neck Support Caul

A neck support caul is a block of wood with a curve cut into the top and lined with a soft material like cork. It is used to support the neck while working on the guitar, and is especially useful when stringing and

setting up the nut and saddle. These can be made very easily, or they can be bought from a guitar making supply house.

Needle File

Very thin files that are used for delicate shaping and come in different profiles are called needle files. These are used for shaping and slotting the nut, and can be used on the saddle as well. A set of needle files can be had for a very low price, and they are often sold at fine woodworking stores and small hardware stores.

Nitrile Gloves

A latex alternative, nitrile gloves are light blue and come in boxes with several inside just like latex gloves. Great for people with latex allergies, these disposable gloves protect the hands while applying finishes. Dying the fingers brown for three days is not as fun as it sounds, so use gloves whenever finishing and especially when staining.

Nitrocellulose

The main type of lacquer, often referred to as nitro, and used to finish production guitars. See Lacquer for more information.

Nut

The small piece of plastic or bone that sits at the base of the headstock and is used to hold the strings in position is called the nut. It sets the scale length by terminating the vibration of the strings at its location, and holds them a fixed distance apart for ease in playing. A well slotted and fitted nut is an integral part of a great sounding guitar, and time should be taken when fitting this piece.

Nut Files

Special files that are gauged to be the same thickness as guitar strings, making very accurate nut slots possible. These files come individually or in a set, and they allow very precise slots to be made that the strings will fit into. Doing this by hand is very time consuming, and using these files makes it much easier and faster to get good and consistent results when slotting a nut.

Nylon String

Any guitar that has nylon strings, and is designed for nylon strings can be called a nylon string guitar. It is usually classical guitars that are referred to by this term, though it can be used for more than one particular style of guitar. Nylon strings require less tension to get them up to pitch, which means that the neck and soundboard do not need to be as stiff in order to be structurally sound. A nylon string guitar is also warmer, having a very distinct sound from a steel string guitar.

-O-

Oil Based

Any finish that uses a petroleum product, or a plant oil as the main ingredient is called an oil based finish. The thinner in most oil based finishes is mineral oil, which is a petroleum product. Plant oils like linseed or Tung oil are natural oils that also make up oil finishes. As a general rule, oil finishes give the wood a more natural glow than water base finishes, and they add more depth. The look of an oil on wood finish is still unmatched by any water based product out there, and has to be seen in person to really be appreciated. Oils just have a special way of enhancing the look of wood that water simply cannot match. At least at this point in the development of water base finishes, oils are still the clear winner.

Off Cut

Any scrap or waste that is cut from a usable piece of wood can be called an off cut. It is simply a term for the pieces removed from a larger piece of wood as it is being worked into rough shape with tools. It is worthwhile to save off cuts in a scrap bin for use later on as other smaller parts of the guitar. Even the smallest pieces of scrap can be used to make fret dots, inlay pieces, and other small items if they are saved in a place where they will not end up lost or on the floor.

On/Off Switch

A simple light switch that can handle household current and be used as a method of turning off a shop made tool is an on/off switch, and they are available at any hardware store. These are sold with exposed wire terminals, so a box will also be needed if it is going to be used in a shop jig. Safety is very important when working with electricity, and a box should be bought or built for the on/off switch to conceal the wiring and prevent accidental contact.

One Way Truss Rod

A truss rod that can only be actuated in one direction, normally making the neck bow backwards against the tension of the strings. These

are the most simple types of truss rods, and are common on many instruments.

Open Geared Tuners

Tuning machines that have exposed gears, showing where the post, gear, and knob intersect are called open geared tuners. These have a vintage look, and can be very high quality. On the opposite side however, many very inexpensive tuners are open geared because it requires less material and less steps to manufacture. Some people like the open geared look, and some do not. It makes no difference in the performance of the guitar, assuming both sets of tuners are of equal quality, which type is used.

Open Grained

Also called open pored, See Open Pored for more information.

Open Pored

Wood that has very large openings on the surface that are used when the tree is alive to transport water, is called open pored wood. It can also be called open grained wood, though the pores are what the openings really are. These kinds of woods, species like Mahogany and Walnut, will need to be filled with paste filler in order to get a totally level and glossy finish. The open grained look does have its own unique qualities though, and an oil finish does look good on un-filled pores.

Opti-Visor

A magnifying lens that is set into a head band, and used for working with very small items is the opti-visor. This is the name brand of the most popular product on the market, though there are other companies that make a similar item. The magnification is great for working on inlays that have many small details, or for looking very closely at a piece of wood for sanding scratches. The magnifier flips up when not needed, then easily back down for an easier time working with small inlay pieces.

Orbital Sander

An orbital sander is a type of palm sander that moves the sanding pad in an oscillating fashion rather than in a circle. This provides a better sanding effect, and the entire pad moves at the same speed, unlike a

circular motion, where the outside will spin faster than the inside. Measured in orbits per minute, pick out a well made and name brand sander because it will be used a lot, and for many years.

Orbits Per Minute (OPM)

On an orbital sander, the measure of the maximum speed is measured in how many orbits per minute it can perform. It is not an extremely accurate measurement though, because it is taken as a no load speed, which means the maximum speed it can orbit while held in the air. Obviously, without any resistance it will orbit much faster than when it is held against a piece of wood, however there is really no other way of getting a measurement that is fair and uniform. It is abbreviated as OPM, and generally speaking a higher OPM is better than lower, because it will sand the surface faster, resulting in a smoother surface more quickly.

Orchestra Model

A type of guitar with a smoother and more elegant body shape than a dreadnought, and more consistent tonal range is the orchestra model guitar. This is one of the few classic shapes, and is often times fitted with a cutaway for easier access to the higher frets. These work well for finger style guitar playing, and have a very even and solid tone. These also tend to have a cutaway on the treble side.

Oriented Strand Board (OSB)

Called OSB for short, oriented strand board is a type of particle board that is made by arranging thin chunks of wood and drenching them with resin before pressing them into a flat board shape. The beauty of OSB and particle board is that it makes use of pieces of wood that are too small for almost anything else, saving them from being trashed. This kind of wooden material should only be used for making jigs and fixtures, and it is very inexpensive when compared to regular plywood.

Out Feed

The area of a woodworking machine where the wood exits is called the out feed. It can be as simple as a tray, or as elaborate as a system of rollers meant to guide very long pieces. Planers have a small tray that flips up and down for an out feed, and table saws have extensions that can

be stood behind them to catch lumber as it exits. Keeping the out feed table lined up well with the machine is important, as a poorly aligned out feed can cause jams, kick backs, or snipe in the case of a planer.

Outside Mold

The most common mold used in guitar making, it is where the profile of the guitar is cut out of the center of a larger board, and the guitar is assembled inside of it. These are usually a few inches tall, and a little larger on all sides than the body of the guitar. They are made from plywood or MDF, and split down the middle with hinges and a hasp so it can be opened for removing the guitar body. The outside mold is well worth making, as it helps keep the back, side, and top joints at 90 degree angles when gluing everything together. An outside mold is easy to make, or they can be purchased in many guitar shapes. A mold for each guitar shape is worth having around the shop, as they make the overall project much easier.

-P-

Padauk

An African species of wood, Padauk is bright orange when freshly cut, and over time it oxidizes down to a deep rich brick red coloring. The wood exhibits amazing figure, and displays many shades of red with black streaks in between them. It is a hard wood, suitable for backs, sides, bridges, fretboards, and peg head veneers. It machines well, carves well, and takes a finish extremely well. The only trouble working with Padauk is that the sawdust is a very effective red/pink dye, so it needs to be kept away from any light colored wood. The soundboard in particular will need to be sanded last, in order to remove the slight pink hue that will build up as Padauk sanding dust comes in contact with the top. It is not a huge problem to work with, it just requires paying attention to how the top and bindings look before finishing.

Painters Tape

The trade name for the blue rolls of masking tape which are in the painting section of the hardware store. This tape has a lower tack than regular masking tape, which means it can be removed easier and with less chance of ripping out wood grain. This is a perfect tape to attach binding strips and purfling strips with, because it holds well enough to do the job, yet still comes off in the end.

Palm Sander

The generic term for any sander that can be held in the hand and is electric powered. Examples would be a hand held disc sander or orbital sander. See Orbital Sander for more information.

Parallel

When one object runs in the same direction as another object, they are said to be parallel. Two streets that run directly east and west would be parallel, as well as two streets running north and south that never intersect.

Parlor Guitar

Smaller guitars that were popular many years ago and are now enjoying a little resurgence in popularity. These are usually around 3/4 the size of a regular guitar, tuned the same way, though not as powerful as a full sized guitar. However, with modern advances in amplifiers and pickups, the size of the guitar does not matter as much anymore.

Particle Board

Particle board is another name for oriented strand board, though some people use the term to describe any kind of plywood or machine made wood. See Oriented Strand Board for more information.

Paste Wax

The most commonly used paste wax is called Johnsons Paste Wax, and is sold in short circular cans, about a third the size of a paint can. This is a mixture of waxes that are normally too hard to apply to wood, however they are mixed with a solvent to make a paste. This paste is easy to apply to the surface of any wooden project, and once the solvent evaporates, all that is left is the wax. Wax all by itself is a terrible finish. It will fall off at the slightest scratch, melt as it is being handled, and allow moisture through within days or weeks of being applied. The only real reason to use a wax, is over an existing finish to shine it up for a while. Paste wax can be deposited into a piece of cheese cloth and rubbed on the surface and left to dry until the whole instrument hazes over. Then the haze is buffed off with a dry cloth by hand, leaving the wax behind.

Peen Over

The end of a nail or metal bolt can be caused to flair open and enlarge slightly, making it impossible to remove from a hole the same size as its shaft. This is done with a hammer by striking the end many times in order to cause it to mushroom a little bit and expand. If pins are needed in any shop made clamps (like the cam clamps in this book) they can be peened over to hold them in place.

Peg Head

The part of the guitar neck that is above the nut is called the peg head, and also called the head, or headstock. See Headstock for more

information.

Peg Head Reamer

This tool is used to create a tapered hole in the headstock for tuners that also require a tapered hole. Many tuners can be installed with standard drill bits and vertical holes, however some will need a reamer and a tapered hole. If a reamer is not available, select tuners that do not require a tapered hole. No style works better than another.

Peg Head Veneer

There is a very thin piece of wood that is glued to the peg head, which provides a uniform backdrop for the tuning machines, and it is called the peg head veneer. It can be made from an actual veneer sheet, which is extremely thin, or it can be made from a slightly beefier piece of wood, around 1/8" thick. If the veneer is being made in the shop, it is very hard to get it any thinner than 1/8". Factor this into the guitar peg head thickness, and allow for a slightly thicker veneer when planning for the neck. An exotic piece of interesting wood can be used as the peg head veneer, and it will draw attention to the guitar without altering its sound.

Penetrating finish

Any finish that soaks into the surface of the wood can be called a penetrating finish. This is kind of a misnomer through, because all finishes will soak into the wood a little bit, and the rest will dry on top. When referring to penetrating finishes, the bulk of educated finishers will be talking about oils instead of varnishes or shellacs, because oils tend not to leave much at all on the surface unless really built up. Varnishes and shellacs build up on the surface quickly, which is why they are not talked about in the same way as oils are.

Perpendicular

When two lines meet or two objects meet at a 90 degree angle, they are said to be perpendicular to one another. The letter T has a vertical line and a horizontal line meeting at 90 degrees, and they are perpendicular. The strings meet the saddle in a perpendicular fashion, as well as the strings passing over the nut.

Pick Guard

Located on the front of the guitar and used to protect the soft Spruce from scratches, the pick guard is a piece of plastic or wood that is glued, screwed, or taped near the soundhole. This piece is normally made of some sort of plastic on production guitars, but should be made from exotic hardwood veneer on a handmade guitar. They come in many shapes, though a modified tear drop shape is usually the standard on an acoustic guitar. Custom shapes are encouraged, as long as they are not too big. A very large pick guard will interfere with the natural motion of the soundboard, making the guitar less efficient, and possibly muted.

Pickups

Any electronic method of taking the vibration from the guitar and transferring it into an amplifier without using a regular microphone is called a pickup. These are most commonly found under the saddle or attached to the underside of the soundboard on acoustic guitars, and right under the strings on electric guitars. Pickups can be made in many configurations, and there are hundreds of brands, types, and wiring methods. There is a whole subject in itself to the task of wiring pickups for certain sounds, and in certain switching patterns and arrangements. Anyone really into electric guitars should spend some time learning the finer points of working with guitar electronics. For acoustic guitars, most pickups are self contained, or sold with modules that do all the heavy lifting. They are simply installed on the guitar, and the amplifier does the rest.

Pigment Stain

Any stain that uses pigment particles which are brushed onto the surface and change the color of the wood. Pigment stains contain solid and opaque particles, which is different from a dye stain that is not opaque. Pigment will lodge itself in scratches and open grain, highlighting them for all to see. If any scratches were missed in sanding, a pigment stain will point them out and put a spotlight on them. If several coats of pigment stain are used, it will begin to blur the grain coloring, and eventually it will become completely opaque. Pigment is also in paint, which is why it cannot be seen through. If enough coats of pigment stain are applied, it will simply look like a solid paint layer rather than a stain.

Pilot Hole

When screwing one piece of wood to another, especially in solid wood, it is a good idea to drill a hole first to prevent splitting. This hole is called a pilot hole. If two boards are being screwed together, the first board will need to be drilled with a hole that is a tiny fraction larger than the threads on the screw. The second board will need a smaller hole, the same size as the shaft of the screw, measured between the threads. In this manner the head of the screw can pull the second board freely towards the first, which the threads are digging into, pressing the two of them tightly together. Drill pilot holes for jigs being made in the shop and they will go together much more smoothly.

Pipette

Pipettes are thin plastic tubes with a reservoir on one end, and used to dispense glue into a very tight spot that cannot be reached with the glue bottle. They are disposable, inexpensive, and can be helpful when doing inlay work.

Plane Iron

A small metal blade located inside a hand plane which cuts and removes wood is called a plane iron. It can be removed for sharpening, and replaced if damaged or lost. If the plane iron is kept deadly sharp, the tool will work far better and cause less frustration while trying to learn how to use it. A few minutes spent sharpening the plane iron will be paid back as soon as it is used.

Planer (Thickness Planer)

The power planer is an electric tool which uses a rotating head with knives to even out and thin pieces of wood. The cutter is usually attached to a moving head, or a stationary cutting head is adjusted by moving a plate up and down. A piece of wood is fed through the planer, and it comes out the other side a little thinner. The tool is adjusted thinner still, and the wood is sent through again. Each pass will only remove 1/32" or so, but the exiting board will be completely flat on both faces (assuming the board is flipped as it is worked) and at a consistent thickness. A planer is a great tool to have in the shop, because it allows the craftsman to make use of rough sawn wood, which is less expensive than surfaced wood. The

planer can take a piece of really rough wood and put a factory face on it, which will be very smooth and nice looking. Also, it makes gluing two large pieces together very easy by helping create perfectly flat gluing surfaces.

Planing

The act of removing wood in thin sheets from the face of a board in an effort to reduce its thickness is called planing. This can be done by hand or with a machine, and has an end goal of a uniform thickness across the entire piece. Planing by hand is a craft and an exceptional skill. It can be learned by anyone who will give it the time and attention any skill deserves, and spend some time learning how to properly sharpen and care for a wood plane. Those of us who want a quicker way to get the same result can turn to a power planer, which will reduce boards to a certain thickness very rapidly. Though they have a harder time with interlocking grain, or grain that changes directions, power planers do a great job and they do it without very much of a learning curve.

Plate

A common term for the soundboard and the back of the guitar, each one of them being a plate, and referred together as plates. The plates are important for sound production, especially the top or soundboard. This is the piece that does the majority of the vibrating, which produces the sound we hear when the guitar in played. The back plate needs to be strong and domed slightly in order to reflect sound forward against the soundboard, increasing the vibration effect.

Playing In

Brand new guitars take a little playing in order to get all the pieces working and vibrating well with each other. This is the reason an older and more often played guitar will sound better (all else being equal) than a rarely played or new guitar. Simply playing the guitar and allowing it to vibrate enhances the sound quality of the guitar every single time it is done. The change will be dramatic in the beginning few hours to weeks, and then it will take months or years to slowly change after that. Guitar makers often do interesting things in order to hurry up this process. One method is to use a small device that strums the strings constantly, and another is to

place a speaker near the soundboard and play loud music. This is done for several hours or days, and artificially ages the instrument, giving it an older and played in sound.

Plug Cutter

A small metal edged tool that is used in a drill press to cut a cylindrical piece of wood from a larger piece. These come in varying diameters, however the 1/4" and 3/8" would be the most important to guitar makers. These little plugs can be inlaid into fretboards as round fret dots, and they can be made from any species of wood that is available. Even small scraps can be turned into usable fret dots, making this a very useful tool. Pick up some exotic wood from the hardwood store and make some really interesting fret markers that are far more to look at than the standard white or black dots.

Plywood

Plywood is made out of several thin layers of wood, fillers, and sawdust/glue mixtures, in order to arrive at a board that is a certain thickness. The outside layers are faced with a nicer looking species of wood to give the board a nicer look, and it can be found with almost any species on the outside. For guitar makers, plywood is a less expensive material for bench tops, router table tops, and other jigs and projects that will require a better class of board than particle board or oriented strand board. The advantage to plywood over real wood is that plywood is dimensionally stable, and will not bend, warp, or twist with changes in temperature and humidity. For bench tops and small tool table tops, this is a real advantage because these surfaces will need to remain flat in order to be effective. A small router table can be made with thick plywood, and will perform well.

Polish

A product used to clean and beautify the finish on a guitar and is applied by wiping is called a polish. Many kinds of polish exist, though any with silicone should be avoided. Silicone never comes off the surface, and will work its way into the tiniest crack in the finish, staining the wood. This will be easy to see on the surface, and it may even cause the finish in that area to begin falling off. If polishing a hand applied oil finish, a little wax or a vigorous rubbing with a piece of stiff cloth like burlap or duck cloth is all

that is really needed. Most polishes leave a wet film on the guitar that will look shiny for a few hours or a few days and then it evaporates anyway. Care for the finish by not letting the guitar get dusty or wet, and the finish should always look nice.

Polishing

The act of buffing, applying compound, or rubbing out a finish to a high gloss. Polishing can be done in many ways and using many different tools, however the goal is the same. Wood is polished until a certain gloss level is reached, and is uniform all over the guitar. Technically this is an optional step, since most hand applied finishes will have a good measure of gloss to them.

Polishing Compound

Very fine ground stone is mixed with a paste and rubbed on the surface of the finish to bring out the shine. Polishing compound is the name for any super fine grit mixed with a paste or wax component, that is meant to be rubbed on the finish after it cures. A great place to buy these compounds is in the automotive section of a large store, or a dedicated auto parts store. McGuire's sells an automotive rubbing compound and a swirl remover that are meant for polishing out cars to an extreme gloss. These products can also be used on a completely cured finish, bringing it up to the same level of gloss. The major finish manufacturers also sell polishing compounds in varying grits.

Polyurethane Glue

Made for gluing very different objects together with a super strong bond, polyurethane glue is great for larger projects, but not a great choice for guitar making. Polyurethane glue expands as it dries, leaving a very dense and rock hard residue. It is great for filling gaps, however there should be no gaps in a well fitting joint. Stick with AR glue for any wood to wood joints in the guitar, with Titebond Original being the best choice.

Pony Vise

Actually a brand name, though eventually becoming the name for the item, this is a vise that sits on the bench and is used for light to medium duty holding. It has two metal jaws and a curved section below

them for holding round items. The vise is screwed to the bench top, usually in the corner or on the side, and is used any time a small vise is needed. These are inexpensive and can be found in any hardware store. Especially if a front vise is not in the budget, it is surprising just how much a small or medium sized pony vise can do.

Pop The Grain

When a special step is taken to enhance or bring out the grain of a piece of wood before final finishing, this is called popping the grain. It is most often done with an oil, which penetrates and brings out the chatoyance. It can also be done by adding a little dye stain to some shellac, or dying the board directly and sanding most of it off before applying several clear coats. This step is already built into any oil finish, because the oil will have the same effect as it is applied to the guitar. As long as a hand applied oil finish is going to be used, the grain will pop automatically. Figured Maple and Mahogany really pop when an oil is applied, and has to be seen to be believed.

Pore Filler

Any dedicated product that is used to fill in the open pores of a piece of wood before finishing can be called a pore filler. Pore fillers are essentially colored paste in a can, which is wiped onto the guitar and forced into the pore openings. After it has dried, any remaining on the surface is sanded back, leaving a very flat base to begin building a finish upon. The only way to get a mirror finish that can reflect really well is to fill the pores. Open pores leave small pits in the finish, and these pits scatter the light from the reflection in several directions. The light needs to hit a flat surface to be reflected back directly, so the pores must be filled if a mirror finish is to be accomplished.

Position Markers

Another name for fret markers, these show the locations of certain frets easily, and make playing the guitar easier. See Fret Markers for more information.

Profile

The profile of a piece is how it looks when viewed from the side, or an outline of the shape of the sides. The profile of a router bit is the shape it creates, and the profile of a person would be their silhouette or shadow outline.

Propane Torch

This is any torch that uses propane as the fuel source. It is a type of blow torch, See Blow Torch for more information.

PSA Sandpaper

PSA is short for Pressure Sensitive Adhesive, which is how these sandpaper sheets and discs stick to their sanding pads. When using a disc sander or a sanding wheel for the buffing arbor, PSA sandpaper discs stick to the pads and grab even harder when pressure is applied. They can be pulled off easily enough or wetted to assist in removing them, and another piece easily stuck in its place.

Pull Cut Saw

Any saw that cuts on the pull stroke is called a pull saw. See Dozuki for more information.

Pumice

Volcanic rock that is ground up and used as an abrasive is called pumice. Before woodworkers had sandpaper, they would use mineral oil or water and pumice, which made a slurry, and effectively sanded with a very fine grit. Sandpaper is really just pumice that is stuck to paper and a little easier to use. There are grades of pumice according to its coarseness, and if polishing be sure to use them in the right order. Use the most coarse pumice first, the finer pumice would be used second, and the whole thing can be followed up with rottenstone, which is finer than both grades of pumice.

Purfling

Very thin strips of natural or dyed wood, used to embellish the joint between the sides and the top are called purfling. These strips are manufactured in varying thicknesses and designs, which can be used to enhance the look of the binding. Purfling strips can also be inlaid in concentric circles around the soundhole as a rosette, which is a good

looking and easy approach to decorating this area. These can be bought from guitar supply houses or made in the shop from layers of veneer, and cut into strips on the table saw. Herringbone purfling is one of several classic patterns which have stood the test of time and have been used on instruments that are hundreds of years old. See Herringbone for more information.

Purfling Cutter

This hand held tool uses a guide pin and a very sharp set of scoring blades to mark the location of the purfling on the soundboard. The blades can be adjusted for different thicknesses of purfling, and for how far into the rim it will cut. With acoustic guitars, a purfling cutter with one blade can be used to mark and score the purfling location if the ledges are going to be chiseled by hand. Or, a single piece of purfling can be inlaid into the top of the guitar in the same way it would be inlaid on a violin. Leave about half an inch or less of a gap between the edge of the soundboard and the location of the purfling. This is an interesting look, and it harkens back to the classical instruments and how they were made.

Purple Heart

Coming from Africa, this species of wood is a solid purple color through and through. It is a very dense wood, a little brittle on the corners, and very beautiful. It is a bit tricky to work with, dulling tools and burning when machine sanded, but it can be forced into fretboards and bridges. The faces of a mallet will last forever if made from Purple Heart, and nicer jig pieces made from it will also stand the test of time. There are a few guitars out there that have a Purple Heart back and sides, though it is not done as often. A very hard wood, it would have great qualities as a back and sides on a custom guitar.

Push Stick

This item should be called the finger saver, or the woodworkers friend. A push stick is a piece of sacrificial material shaped like a small stick, which is used instead of the hands when working close to a table saw blade. They can be store bought or made in the shop, and really any piece of scrap will work just fine. It is far better to have the stick destroyed by the blade than to lose a finger, and there is no reason not to use a push stick.

PVA Glue

Polyvinyl Acetate glue, or PVA glue, is commonly referred to as white glue or school glue, and is available everywhere. It is very good at gluing paper projects, however it should not be used for guitar making because AR glue is far better and just as available.

-Q-

Quarter Sawn

When pieces of wood are sawn so that the grain lines run vertically from face to face when looked at from the end of the board, this is said to be quarter sawn. It is not very economical to quarter saw wood, which is why it is usually more expensive. Also, when a piece is flat sawn, a few of the pieces will actually end up being quarter sawn by default, which means in a regular tree there will be very few quarter sawn pieces. The rarity in this case also leads to the increase in price. For stiffness and instrument making needs, always select well quarter sawn pieces of wood. Flat sawn wood is harder to bend, is not as stiff, and does not have the same look as quarter sawn wood. Technically, flat sawn pieces would work fine for the back, or the fretboard, but every other large piece should be quarter sawn.

Quick Clamp

Bar clamps that have a quick release lever and a trigger style clamping mechanism are called quick clamps. They are really bar clamps with extra features that make then faster to use, and easier to move around. These clamps are well worth having several of, and they will come in handy when one hand is busy holding something in place and cannot let go. The clamps can be opened and set with one hand, which is not possible with most regular bar clamps.

Quilt

The name given to a certain figure that is prevalent in many wood species, especially Maple, which looks like many clouds all laying next to each other. It has also been compared to a ruffled blanked, laying bunched up. Quilt is the type of figure, and the piece of wood is said to be quilted.

-R-

Rabbet

A groove or a recess that is cut into the edge of a board, leaving a two sided ledge. A router is typically the tool used for cutting rabbets, however they can be done by hand with a chisel, mallet and the patience of a saint. Normally a rabbet bit set for the router will be used, because several different depths of rabbet can be made simply by changing the bearing on the router bit. Rabbets are made for the binding and purfling strips to sit in, inlaying them into the edge of the guitar.

Rabbet Set

A set of bearings of different thicknesses as well as a straight router bit and a way of changing bearings is called rabbet set. The bearings come off with an allen wrench usually, and each bearing allows more or less of the cutter to extend passed its surface. The more cutter, the deeper the rabbet will be, and this can be changed very easily. A good rabbet set is not terribly expensive, and can make routing binding ledges a walk in the park.

Radius

When referring to circles, the radius of a circle is half the diameter, or the distance from the center of a circle directly to the edge. More than one radius are called radii, and there are several radii involved in making guitars. Any curved surface can be seen as being made up of circles, each one of those circles having a specific radius.

Radius Dish

Used with a go deck or similar press, a radius dish is a large round piece of flat wood with a slight concavity in the center. This allows a guitar top or back to be pressed against it while gluing the braces, which will result in the plate being domed slightly after the glue has dried. These can be bought or made with a router and a jig, and two different radii will be needed, one for each plate. Weights can also be used to hold the braces in place while drying in the dish, and several gym weights will give plenty of clamping pressure.

Radius Gauge

These come usually in four sided configurations, with a different radius cut into each side. The gauge is lined up against a fretboard or other curved surface and checked, looking for light passing through. Once the right radius is found, the gauge will sit perfectly even against the piece being measured, and no light will shine through. This is the matching radius. Normally these are used for checking how accurate the fretboard radius is, and are a useful way of telling how much more sanding needs to be done. For compound radii necks, these are really important because the progress will need to be checked often as the fretboard is sanded.

Radius Sanding Block

Made and sold by the guitar parts suppliers, these are wooden blocks with a radius of a certain size carved into the bottom of it. The other side is carved for easy holding in the hand, and a piece of sandpaper is wrapped around it when being used. These are great for doing the hard work of applying a radius to the fretboard by hand. Start with 80 grit paper on the block and remove the bulk of the waste wood, making full strokes across the board. Switch to 150 grit to remove the 80 grit scratches, and further refine the shape. Finally, finish with 220 grit paper, and check with a radius gauge and a straight edge for accuracy before fretting.

Raised Grain

When wood becomes wet, the fibers swell and burst through the surface, which can be felt as rough patches. This is called raised grain, and is done intentionally before finishing so that the finish can be as smooth as possible. Many finishes will raise the grain themselves, which causes an uneven feel in the wood after the first coat. This has to be dealt with immediately by sanding through most of the coat and removing the rough feeling fibers. After this, the rest of the finish can be applied like normal. The extra step of raising the grain only takes a little extra time to complete, so make sure to raise the grain and sand it level before applying a finish.

Rasp

This file like tool is a long piece of metal with teeth that are designed to remove wood quickly and efficiently. They come in many sizes as well as types of teeth. Some are more aggressive than others, though they

will all remove wood very well. A coarse and a fine rasp are worth having in the shop because they will save so much time over sanding, and they work the wood better. These can come with or without handles, and a handle can be made or bought for any of them.

Razor Blade Knife

Another name for a hobby knife, which uses a razor blade to cut small and delicate work. See Hobby Knife for more information.

Re-Fretting

The act of removing an old set of guitar frets and installing a new set is called re-fretting. This is often done with an older instrument that had had lots of playing time, which will wear down the frets in heavily played areas. This will start to cause buzzing, which usually prompts the player to have the guitar worked on. The process starts by removing the old frets carefully, and then cutting and installing new frets in the same slots. The frets are leveled and recrowned, restoring the neck to its original playability.

Re-Sawing

When a rough cut board is sawn down to usable sized pieces, this is called re-sawing, and is part of the cost when buying finished lumber. A back and side set that are already surfaced and cut to size is three to five times as expensive as the same species of wood bought in standard lumber dimensions, and cut down to the correct size. The makers know that customer will be buying already sized and sawn pieces because they do not have the tools to do it themselves, or they do not know how. There is a premium charged for this service, because the makers have tool costs and time to add to the price. If pieces can be resawn at home, which is easier than it sounds, lots of money can be saved in the long run. A major goal of this book has been to help guitar makers save money by teaching them how to make as many pieces at home as they can. The entire first chapter shows how to make every guitar blank needed in the shop, without paying any extra premium for wood that is already sawn to size.

Reamer

A hand held tool used to taper holes for bridge pins and tuning machines. See Bridge Pin Reamer for more information.

Reciprocating Saw

Used more in demolition work and construction, a reciprocating saw is sometimes called a saws-all, and is a hand held saw with a very aggressive cut. This is a handy tool to have if back plates are going to be split open on the table saw, and the center of the cut finished with a hand saw. Compared to the hand saw, the reciprocating saw is lightning fast at cutting through the part of the board that the table saw cannot get deep enough to reach. This is the only real use for this kind of saw in guitar making since it is not a fine woodworking tool by any stretch of the imagination. I am sure there are a few constriction workers out there who are artists with a saws-all, however it really only serves the one guitar making purpose mentioned above.

Reclaimed Lumber or Wood

Wood that was once built into something else, and harvested for use as another item is called reclaimed lumber or wood. This can be as simple as taking apart a dresser instead of throwing it out, saving the pieces of wood. These pieces are now reclaimed wood, because they were once destined for the trash and now given a second chance as something else. Old farm houses and ancient buildings are picked through for usable pieces of wood, and sold as reclaimed lumber to people interested in having several hundred year old timber in their woodworking projects. The wood itself is not necessarily better than any other wood, however it definitely has more history than a new piece. A piece of reclaimed Rosewood from an old ship would add an interesting twist of history to any guitar having a bridge from that particular piece. There is something powerful about having a historical piece of material on a guitar build, and reclaimed lumber comes from so many historic places that there is something for everyone.

Regular Tooth

On regular tooth blades, the teeth are perpendicular to the surface being cut, which means they use a scraping action to remove wood from the cut, rather than a slicing action like a hook toothed blade. This is the standard type of band saw blade, and is fine for everyday woodworking.

It may not cut as well when sawing through very large pieces, so go a little slower to allow time for the chips to be removed, and for the blade to make the cut.

Resonance

The quality or presence of sound, expressed through the power and lasting sound created by the instrument. A very resonant guitar will be powerful and the tones will sustain for an acceptable period, filling the immediate area with sound. This is a good quality to look for in a guitar, which is the opposite of the weak and lifeless sound of poor or inferior instruments.

Respirator Mask

When finishing, it is a good idea to use a respirator mask, which is a specially designed mask that has a chemical filter for the air being breathed. The fumes from a finish are trapped and neutralized by the filters, and kept from being breathed into the lungs. These filters screw on and off, and are good for a certain period of time, which the maker will specify on the box. They are relatively inexpensive, and are a very good investment in personal safety.

Responsive

The ability of a guitar to be able to change the touch of the fingers or the pick into sound, is called responsiveness. A guitar that is responsive is one that can create sound at the most delicate of a touch, and does not require heavy strumming in order to bring out the sound. A good guitar will make noise when someone sneezes in the same room as the guitar. The strings will vibrate a little bit, and make a faint sound that can be heard in a quiet environment.

Rheostat

This is a device used to limit the amount of current that flows through a set of wires, which will have the effect of a temperature control for an electric bending iron. Rheostat is the fancy name for dimmer, which is found on almost every living room light, allowing it to be made dimmer or brighter with a turn of a knob. These are sold in any hardware store in the electrical section, and are coupled with an on/off switch for more control.

Purchase a rheostat that matches the electrical requirements of the item being controlled, which will ensure that the whole system does not fail when in use. Normally, there is a wattage requirement to the heating element, so select a rheostat that can handle the same or a little more wattage than listed on the piece.

Ribs

Another term for sides, this is normally used to refer to violin and classical instrument sides rather than guitar sides. See Sides for more information.

Rip Cut

When a piece of wood is cut parallel to the edge, it is called a rip cut. It does not matter if the board is an inch long and a foot wide, as long as the board is being cut from end grain to end grain, then it is still called a rip cut. The most common tool for ripping wood is the table saw, and makes ripping wood to width a very easy task. Necks, fretboard blanks, and other pieces will have to be ripped in the shop, and this can be done on the table saw, band saw, jig saw, or circular saw.

Riving Knife

This piece is present on nicer table saws, and it is located behind the blade. Normally they are shaped like a shark fin, and the purpose of the accessory is to separate the piece of wood as it exits the table saw. The riving knife lifts up and down as the blade is raised and lowered, and can be removed and replaced if it is ever damaged.

Rosette

The decoration around the soundhole is called the rosette. It can be very simple, perhaps a single ring of solid colored purfling inlaid close to the edge of the soundhole. It can also be a very elaborate mosaic of small wooden dots that come together to form an interesting design. The rosette is a place for a guitar maker to express themselves, and show off some of their woodworking skills. Inlaying a rosette takes some patience and effort, however it is not beyond anyone who is making a guitar, even for the first time. Special curved pieces of mother of pearl and abalone are also sold for inlaying around the soundhole, and so are other solid pieces of wood. A

circle cutting jig can be used to cut out solid wood rosettes from veneers, and purfling can be glued to their inside and outside edges.

Rosewood

The premier guitar making wood for beauty, ease of working, and sound. Rosewoods come in a few varieties, however Indian Rosewood is the most common. It is an oily wood that has a dark coloring with very interesting grain and deep tone. The wood is easy to plane, bend, and shape, taking a finish really well. This wood is also the standard for fretboards, bridges, bridge pins, and end pins. Many peg head veneers are also rosewood, darkening the headstock and adding contrast to the bright tuning machines.

Rotary Tool

The technical name for the Dremel tool, which is actually a brand name which has become the most commonly used term for the item. See Dremel tool for more information.

Rottenstone

This is an extremely fine powdered rock, which is used with oil or wax to polish the surface of an instrument by hand, bringing out the natural gloss of the finish. Rottenstone should be used after pumice, which is more coarse, and will microscopically polish the surface to a gloss. There are products with rottenstone in them already, and it can also be bought as a powder and mixed in the shop before use. A hand rubbed finish is a thing of beauty, and a very nice gloss can be achieved without any expensive buffing equipment. It only takes a little more time to do it by hand, and the gloss from a polished finish is well worth it.

Round Bottom Plane

Mostly used in arch top guitar making and violin making, a round bottom plane is a small hand plane with a rounded sole and a curved iron. These are used to remove small bits of material from the surface of the guitar, creating the arched top shape. These can be bought or made in the shop fairly easily, the only tricky part is getting someone to make the plane irons to fit them. A larger plane iron can be cut in two pieces, with one of those pieces being twice as large as the other. The smaller piece can go into

a tiny round bottom plane, and the larger one into a bigger unit. Rounding the edge takes some practice, but it can be done on a slow speed grinder, and once the bulk of the shaping work is done on the iron, it takes only a little time to hone the tool each time before use.

Round Nose Bit

This is a type of router bit with a cutter head that is rounded on the tip, creating a half circle when pulled through wood. A 3/16" round nose bit is great to have when making the slot for the truss rod, as it will make a round bottom slot that holds the truss rod snugly. Since this bit will only be used for this one operation, a single round nosed bit should last a lifetime as long as it is not lost. Purchase a good name brand bit because it will make cleaner cuts and not drag or tear the wood. Also, make several passes until full depth is reached, instead of one deep pass.

Round Over

A router bit that follows the edge of a piece of wood, leaving a rounded profile on the corner is called a round over bit. The radius of the round over will vary from bit to bit, and the depth can be controlled by how far out the bit sticks passed the router plate. If binding the guitar seems like an unreasonable challenge, the corners can be rounded over slightly, giving a more finished look than simply leaving them trimmed flush. Do not round them too deeply, otherwise the kerfing will be exposed, however round them until the glue line between the sides and plates is barely nicked with the round over bit. After that, sand the router path to smooth out any bumps and the guitar will have a more finished look to it.

Router

This electric tool has a motor attached to a flat plate with a couple handles. The motor turns a collet that takes any number of specially made bits with different cutting heads on them. The bit determines what the router will be doing, and it is an extremely versatile piece of shop equipment. There are several books dedicated to teaching all the secret woodworking operations that a router can do, and any one of them is worth checking out. A small or medium sized router is great to have in the shop, and will make several aspects of guitar making very easy. It does not have to be new and fancy, just a solid functional router that is not too large.

Router Bushing

These metal discs with openings in the middle are used with a router to follow a template. They install on the base plate of the router, directly in the center below the bit. A router bushing will have a collar of a certain diameter which follows a wooden template while the bit cuts out the shape. A set of router bushings will have many different collar sizes, which should suit any application. Be sure to center the base plate on the router before using a router bushing, to ensure that the cut will be even on all sides.

Router Table

A specially made table where the router is mounted underneath, with the bit sticking up through a hole in the center. The router is adjustable up and down, changing the depth of cut, and the bits can be changed while the router is still in the table. The router table also has a fence and a miter slot, so pieces of wood can be fed into the spinning bit with accuracy and confidence. Small and simple versions of these can be built into an existing work bench, especially if a router lift is purchased. The lift is a self contained unit that has a hard plate for the table as well as a carriage that moves the router up and down. An inexpensive way of making a router table is to cut a 1-1/2" hole in the center of a workbench and mount the router under the top. This is done by removing the router base, and screwing it from the top, countersinking the screw heads. If the router is heavy and the table top is thin, it can bow, which will make the router inaccurate, so be mindful of this if going the cheap route. A couple well placed pieces of wood under the workbench top can stiffen and level out a sag if done properly, and a router table is an easier and safer way of using a router.

Routing Template

A routing template is a shape cut out of apiece of flat wood that the router follows as it makes a cut. They are typically used with a router bushing, or a template bit, in order to be able to follow the template without cutting into it. See template for more information.

RPM

RPM stands for revolutions per minute, and is a way to measure how fast something turns. This is tested without a load on the tool, meaning it is held in the air and there is no bit in the collet. It is an unrealistic form of testing that is nothing like real life for the tool, however higher RPM ratings will tend to spin faster when being used as well.

Rubber

The name given to the small cloth pad that is used for applying finish, where a cotton cloth is wrapped around another cotton or wool piece of cloth, which acts as a reservoir, holding extra finish. Also called a pad, the rubber is used to apply finish, and a little squeeze will dispense more finish onto the surface. It can be held lightly to soak up excess liquid, or pressed a little harder to dispense more. This is a very versatile application method, and is normally used with French Polishing.

Rubber Cement

A type of adhesive, rubber cement is great for temporarily attaching sandpaper to wooden blocks, or any time something needs to be attached to something else in a non-permanent way. Spread out a very thin layer of rubber cement on a wooden sanding block and stick the sandpaper in place. Allow it time to dry and adhere, then sand away. Once the sandpaper has lost its usefulness, simply peel it back and throw it away. The glue should come off as well without very much trouble.

Rubber Strap Clamp

When securing the plates to the sides of the guitar, a long strip of rubber can be used, which is wrapped around the guitar, holding the plates against the sides. This strip can be bought online or made from a well washed large truck inner tube that has been cut into a continuous strip. This single large strip eliminates the need to use several clamps, and is wrapped around the body tightly, holding the plates while the glue dries. This can also be wrapped around the body to hold the heel of the neck when gluing this joint, and it has similar holding abilities if wrapped around a binding strip that is being glued into place.

-S-

Saddle

On the bridge, there is a plastic or bone piece which the strings are tightened over, limiting their length. This is called the saddle, and it is an important part of a good sounding guitar. A well placed and correctly carved saddle terminates the strings cleanly, and with a strong break angle. This in turn torques the soundboard, efficiently transferring vibrations from the strings to the top. Most commonly made from cow bone, these are also made from plastic, and other materials. They can also come pre-formed or as oversized blanks ready for shaping.

Saddle Slot

On the bridge, this is the angled slot that the saddle sits in. It is important to make the slot tight fitting and with a completely flat bottom. The saddle must be held snugly in the slot for the bridge to function properly, and it must sit flush against the bottom of the slot as well. Use a router or Dremel with a carbide cutter, or use a 1/8" chisel to cut the slot by hand.

Safe-T-Planer

This is a drill press mounted small planer that is a great tool for the person who does not want to spend the money on a machine planer but owns a drill press. This is a simple three cutter head planer that can be used to remove material from wood, reducing it to a certain thickness. It chucks into the drill press, which is locked to a certain depth, and the piece is fed into it. This tool will work great for flattening out peg heads after sawing out the shape, leveling out laminated neck blanks, and flattening rosettes before final scraping. Inexpensive when compared to a machine planer, and a useful tool to own, this is better used on smaller pieces than larger ones.

Safety Glasses

Clear, shock proof plastic shop glasses that are used to protect the eyes are called safety glasses. A good pair of safety glasses should be used any time there is a danger of getting something in the eyes while

woodworking. They have come a very long way since the large goggles that were the only thing available years ago. Today, safety glasses are as sleek looking as sunglasses, and can protect the eyes from flying pieces of debris as well as floating sawdust. Always wear safety glasses while in the shop, and invest in a nice pair that are comfortable and easy to see through.

Sanding Block

Any pre-shaped block of wood or plastic that is used specifically for sanding is called a sanding block. A piece of sandpaper is wrapped around the bottom of the block and secured in place. The block provides a flat or evenly curved surface which will make the sanding process go much more smoothly, with far better results. Sanding blocks can be made in the shop in many different sizes, and they can also be made on the spot for a specific task. Any piece of wood that can have sandpaper wrapped around it can be called a sanding block, even if it is only temporarily.

Sanding Sealer

When finishing open grained woods, it is sometimes beneficial to seal the surface before applying the first coats of finish in order to level it out and fill in the pores. Sanding sealer is a high solids clear liquid that builds up quickly, filling in the grain and leveling out the surface. On open pored wood, spread a coat of sanding sealer and let it dry completely. In most sanding sealers there are sanding lubricants which help the process by not clogging sandpaper as quickly, though the surface should still be wet sanded to prevent corning. Sand the surface flat, which will leave the sealer in the pores. Now the surface is even, and ready to take a finish.

Sanding Sticks

Any small piece of scrap with a piece of sandpaper glued to it can be called a sanding stick. They are usually skinny and longer than sanding blocks, and are meant to get into hard to reach places as well as provide a little more force to the sanding action. These can be made from scraps in the shop and tossed when used up, or the sandpaper can be removed and more added. Use a rubber cement for making the sandpaper removable after it has been used. Rubber cement can be scraped off when dried and more sandpaper can be applied.

Sandpaper

An abrasive that is the most commonly used method of smoothing out wood. Sandpaper is made by gluing carefully sized particles of several different hard materials to a paper backing. This backing holds them all in place so they are even, and serves as a way of attaching the grit to any of several powered and non-powered sanding tools. The way that sandpaper is graded is on the grit system, which is a numerical representation of how coarse or fine the particles are. A high number refers to finer grit and a low number a more coarse grit. Sandpaper for guitar making can be done with 80 or 100 grit for fast material removal, 150 to smooth out the scratches left by the 80-100, and finally 220 to smooth out the wood surface in preparation for finishing. Finishes can be rubbed out and finely sanded for a smooth feel and look with anywhere from 600 grit paper to 1200 grit paper, with each finer grit making the final look of the finish smoother and more glossy.

Sapele

A member of the Mahogany family, Sapele is essentially Mahogany with an incredible ribbon figure that looks amazing on a guitar. The light to medium brown wood shimmers when viewed at different angles, has an incredible looking grain pattern, and works very easily. Bending Sapele is the same as bending Mahogany, and it sands and carves well too. A great choice for backs and sides, Sapele is relatively inexpensive and makes a very impressive looking guitar. If looking for chatoyance, Sapele has tremendous depth when coated in an oil finish.

Sapwood

The sap wood is the living outer part of the tree, which surrounds the inner and non-living part called the heart wood. This area usually has a lighter coloring than the heart wood, and can have some interesting designs when book matched into a guitar back.

Satin Finish

The first level of sheen after flat, satin finishes have a very subtle sheen and a more natural look for wooden projects. A satin finish can be made by sanding or scuffing a glossier finish until the sheen level drops to a desirable level. It can also be applied directly out of the can, by

selecting a finish that leaves a satin sheen. Many fine guitars have a mild satin glow to them, which is a sharp contrast from the heavy gloss lacquer on the majority of guitars.

Saw

The generic term for any toothed metal item that us used to cut wood. These include all hand saws, all machine saws, and literally anything that uses teeth to cut through wood.

Saw Kerf

The thin section of wood removed by the saw when it makes a cut in wood. See Kerf for more information.

Saw Rasp

A type of rasp made from what look like hacksaw blades that are welded together and then stretched apart to form a lattice. This tool is used by hand to remove waste from wood, and carve necks and heels. Not as aggressive as the Sureform, these saw rasps remove wood easily, and make carving more enjoyable.

Saw Set

The bending of the saw teeth to one side or another of the center line is called the saw set, and it will determine how large a kerf the saw leaves behind. The teeth are staggered left and right just a little bit in order to cut a slightly larger hole than the width of the saw itself. This makes it easier for the saw to go through the piece, because it will have more room and not get caught as easily. Larger tooth sets will remove more material for blade clearance, though most saws have just enough set to clear a path for normal operation.

Saws All

A trade name for a reciprocating saw, this power tool makes quick work of cutting through very thick boards. See Reciprocating Saw for more information.

Scale Length

The distance from the nut to the saddle is called the scale length, and it is used to set the fret locations on the guitar. Western music uses a twelve note semi-tonal scale, where twelve half steps equal an octave. This is why the twelfth fret on the guitar is the octave of the open string. Scale lengths vary a little from maker to maker, and a completely custom scale length is very easy to create, adding another layer of customization to the handmade instrument. Most of the commonly used scale lengths are very close to one another, which is done so for a reason. Too long and too short of scales create trouble finding strings that work well, the problem being that they are either too tight to play well or too loose. If making a custom scale, do not change things by any more than a small fraction, otherwise it can cause problems down the line.

Scalloped Fretboard

Done mostly on electric guitars for shred players, scalloping the frets involves filing away the wooden part between the frets themselves, making a concavity. This allows the string to be fretted without the finger touching the wood, which lets the player transition from fret to fret faster than with a traditional fretboard. The strings can also be bent by pressing harder, allowing more tonal expression from the instrument than before. Scalloped frets are easily done with a round file and sandpaper, and give a guitar an interesting look, and unbeatable speed in playing.

Scarf Joint

This is a standard way of joining the headstock to the neck, and makes a better joint than carving a solid neck from a large piece. It involves making an angled cut near the end of the board, flipping over the piece that is cut off, and gluing it back onto the main board. This method saves wood, and sets the headstock angle, all in one step. Of the few ways of making a neck, the scarf joint is the most intimidating for beginning guitar makers. It really should not be, because as long as the cut is made cleanly and carefully, the pieces of wood will not require too much sanding and planing once the joint has been glued. Try making a scarf joint on a piece of scrap wood that is the same thickness as a neck blank (4/4) but a little narrower. This will make it a little easier to make the cut cleanly and get the pieces lined up. Practice this cut a few times on scrap, then try it on some wider

pieces until the cut can be made easily. After that, making scarf joint necks should be far less intimidating.

Scrap

Used to refer to any small piece of wood left over from making a project or cutting something else to size. Scraps are found money because any time a scrap is used to make something else, the wood was free. Keep a scrap bin so that any piece which could possibly be used for something else is retained. Scraps are great for making clamping cauls, jig parts, and any time a piece of random wood is needed for something. Most of the jigs in this book were made entirely from scrap, making them as close to free as they could possibly get. Have a couple dedicated places in the shop for scraps, and save anything usable.

Scraper Blade

A common name for the cabinet scraper, See Cabinet Scraper for more information.

Scraper Holder

A piece of wood or metal designed to hold a cabinet scraper with a slight bend is called a scraper holder. These make it easier and less fatiguing to hold a cabinet scraper with the proper bend to be used effectively.

Scratch Awl

A metal tool with a wooden handle used for marking directly onto a piece of wood. See Awl for more information.

Scratch Plate

A piece of plastic or wood that is used as a method of keeping pick scratches off the instrument soundboard. See Pick Guard for more information.

Scroll Saw

An electric saw that uses a very thin blade similar to a coping saw blade. It has a long arm with a very deep throat, and a table which can be tilted for angled cuts. The super thin blade is great for making very

delicate cuts, and the saw can also be used for making inside cuts. Templates are a breeze to create on the scroll saw, since the blades are easily threaded through the work piece before cutting. A small scroll saw is a welcome tool in any shop, and can also be used for any light duty cutting.

Seasoning

An older term, seasoning means to allow a piece of wood time to dry out, lowering the moisture content to a level that is usable for woodworking. If a piece of wood were used wet, the project would only last a few days or weeks before the joints would begin to fail, and the project fall apart. Even wood that has been cut and sold in a guitar making supply house should be left out in the shop for at least a few days before working with it. I know that it is hard to get a new toy and not play with it immediately, but it is well worth waiting until the piece has acclimated before working with it. A soundboard can shrink around 1/8" or more from left to right if it ships from a humid area and arrives in a dry area. Letting the pieces have a few days to adjust is good practice, and the chances of having a joint break late in a build will be minimized.

Sharpening

Using any means either manual or electric to restore a sharp edge to a tool is called sharpening. A simple combination stone, which is a sharpening stone with two different grits, is usually enough to take care of the majority of shop tools. There are however many alternatives, including some very high end and expensive power sharpeners. Sharpening is different than honing, and refers to the initial making of an edge. After the edge has been sharpened, honing takes place in order to make the edge extremely sharp, and is a required part of the process.

Sharpening Stones

These rectangular pieces of stone come in many grit levels and are used for sharpening metal tools. They usually require either water or oil as a lubricant, and the tools are sharpened by the stone removing small bits of metal. Many different companies make sharpening stones, and good stones are not cheap, but they will last a lifetime.

Sheen

The sheen of a finish is a measure of the gloss, and is expressed in a few standard ways. Flat sheen would be almost no reflection at all. Satin sheen starts to reflect a little but, however it is still pretty low. Semi-gloss is starting to become shiny and in some pieces is the perfect amount of gloss. Gloss sheen or high gloss sheen is the most reflection, and can be polished to a mirror surface. For most guitars, a satin, semi-gloss, or gloss are the preferred finishes, with none of them being any better than the next as far as protection. The choice between sheen levels is simply a matter of personal taste, and there are reasons to like either or. The can or bottle should say something about the sheen level, if not ask someone in the store or do an internet search and look at some pieces being finished with the same product.

Shelf Life

The amount of time a finish or a chemical will be usable once it has been mixed. The shelf life is typically printed on the can or bottle somewhere as the expiration date. Most finishes have a shelf life of around a year or two, depending on the maker and the formulation. Most shop made finishes like shellac will have about a one year shelf life if kept at room temperature and sealed well. Glues, finishes, stains, and any other liquid chemical used in guitar making will most likely have a finite shelf life. Look at the dates on the cans and make sure that anything being used on a handmade instrument is within the usable date.

Shellac

The name for the product of the Lac bug, which secretes this brown sticky substance onto the bark of trees, and is harvested, refined, and sold. It is mixed with denatured alcohol to make a solution which is then applied to the surface of the instrument, giving it a nice amber coloring. Shellac is a very old finish that has been used for at least 3000 years to protect wooden projects and beautify them. The shellac flakes are dissolved in alcohol and then wiped or brushed onto the surface. As coats are applied, a very pleasing amber coloring will begin to develop, which adds warmth as well as an aged look.

Shop

The place where guitar making is done and all the tools and machines are located is called the shop. It can be very large and loaded with every tool imaginable, or it can be a single car garage with whatever tools can be afforded. Everyone dreams of a great big shop that is bursting at the seams with tools and materials. However, even the most modest shop can still turn out fantastic instruments. Nice tools help, but they are no substitute for a good woodworker and guitar maker. A detailed and knowledgeable craftsman working in an outhouse can turn out better guitars than an inattentive lazy woodworker in a million dollar shop. The person makes the biggest difference.

Shop Glasses

Another term for safety glasses, these should be in an easy to access place in every woodworking shop. See Safety Glasses for more information.

Shop Vac

The brand name for a wet and dry canister type vacuum made popular for use in woodworking and construction applications. This is a powerful vacuum with a large diameter hose, capable of sucking up large pieces of wood, nails, and anything else that can fit through the hose. The air filter is easy to clean, and the canister is emptied simply by removing the top of the vacuum. Many of the canisters for these units are on wheels, making them easy to roll from tool to tool and connect as a dust collector. Fittings for many power tools can be adapted to the shop vac hose size, and it instantly becomes a mobile dust collector.

Side Bending Jig

A large jig in the shape of the guitar side, which uses heat and steam to bend a piece of wood into the correct side shape. These are made with a couple pieces of MDF and sheet metal for the actual side profile. The piece of wood is sandwiched between a couple pieces of sheet metal with a heat blanket and slowly clamped to the form. Once the form and the side cool overnight, the piece is removed and used as a guitar side. Side benders can be made in the shop without too much trouble, and they can use high wattage incandescent light bulbs as their heat source instead of the heating blanket if desired. This process should be a little easier than bending by

hand with a hot pipe, though it will take longer because only one side can be worked at a time. Pieces still need touch ups sometimes on a hot pipe afterwards, so this will not completely eliminate learning how to use a bending iron.

Side Dots

Used to help see where the fret locations are when playing, these small dots are inlaid into the edge of the fretboard, making it easier to know where the notes are while playing. Very thin pieces of plastic rod are normally used for this, however Abalone and Mother Of Pearl dots are used as well. A single dot will go on frets 3, 5, 7, 9, 15, 17, 19, and 21, with a double dot on fret 12. If a fret dot is placed on the face of the first fret, it is a good idea to also put a side dot as well. Brass rod stock can be used for these dots instead of plastic or shell, and it adds a nice detail to the instrument.

Side Spreaders

Used on the outside mold, side spreaders are specially cut cauls that hold the sides against the mold while working on the guitar. These can be made from scrap, and sometimes use turnbuckles as the means of clamping the spreader inside the mold. A piece of wood can also be cut in half and then cut to the needed length and press fit into the mold to act as a spreader. When no longer needed, the cut at the center serves as a breaking point where the spreader can be separated into two pieces and removed. These are useful for making sure that the sides are in the right place for gluing and for notching out the kerfing at the ends of the braces.

Sides

The part of the guitar that keeps the plates at a certain distance from each other, and sets the profile or shape of the guitar. These are typically cut from the same piece of wood so they can be book matched and built into the guitar, so they meet as a mirror match at the bottom. The sides need to be thin enough to bend easily, but strong enough that they will hold up over time as the guitar is played. Look for a species of wood that has a good track record of bending well if selecting a species from the hardwood store. Anything that is sold by an online suppler is usually easy enough to

bend, or when in doubt buy a small piece to test bend before committing to the full size pieces.

Single Coil

In electric guitars, and on some acoustic guitar pickups, a single coil refers to the pickup being made from one electric coil. These can be paired with another single coil pickup and wired for opposite polarities to create a humbucker pickup.

Sitka Spruce

The most common wood species used on acoustic guitar tops, especially steel string guitars is Sitka Spruce. This wood has the highest strength to weight ratio of any wood on the planet, and grows along the Northwestern coast of North America. The trees themselves are extremely tall, and can be several meters wide at the base. Classified as a soft wood, this species produces bright and responsive guitar tops, perfect for steel string guitars. It sands, carves, and finishes well, with a bright shimmer when oiled. Sitka is also the main choice for the internal braces of the guitar, again because it has the most strength with the least amount of weight of any other wood.

Skip Tooth Blade

This type of band saw blade deletes every other tooth, making much more room for waste being removed from the cut. Great for re-sawing and cutting through very thick stock, the skip tooth blade allows plenty of room for the waste to exit. If these large gaps were not there, the sawdust would build up, causing the blade to work harder, heat up, and cause even more sawdust to stick. This is a circular problem that just keeps getting worse, which is why having a blade with every other tooth missing really helps. If re-sawing on the band saw, invest in a good skip tooth blade that has a sturdy spine and is on the larger side, maybe 1/2" to 3/4" wide. This will be large enough to work well, and not so large that it becomes hard to put on the band saw.

Sliding Bevel

Used for checking angles as well as for copying angles onto projects, the sliding bevel is a wooden handle with a metal blade. The metal

piece slides in a long channel and the two parts can be bent into any angle and locked in position by a wing nut. A small sliding bevel is helpful for working out the neck angle, especially if the sides and the top are not quite at 90 degrees, and it can also be used to verify the peg head angle.

Slotted Peg Head

Often seen on classical guitars, though sometimes used for flair on steel string guitars, this refers to a pair of vertical slots in the peg head, where the tuning pegs are located. This creates a pair of long open holes that give the guitar head an interesting look. Special tuners are required for this kind of guitar, and should be purchased and measured before the slotting and drilling begins.

Slow Speed Grinder

A type of grinder that rotates at a much lower speed for sharpening tools. Regular grinders rotate at far too high a speed to be useful in sharpening edged tools. The high speed cuts really quickly, creating friction that heats up the tools. If they are heated too much they lose their temper, and are not able to hold an edge as well as they were. This ends up requiring sharpening much more often, and eventually the need for a new tool. Slow speed grinders rotate around 1700 RPM, which is fast enough to remove material but not fast enough to ruin the temper too quickly.

Snipe

Usually a result of the in feed and out feed tables not being adjusted well, snipe happens when a board exiting the planer gets cut into a little deeper near the end. It is usually the last couple inches of board that are affected, and this part can always be cut off provided the piece being planed is long enough to do so. It is a good idea to allow a few extra inches if the planer being used is known for snipe, and simply cut off the ends before assembling the pieces. Check the in and out feed tables to ensure they are even with the center table under the cutter, and adjust them if necessary. Snipe is usually caused by these being out of alignment, however if that is not the problem, just add a couple inches to any piece being sent through the planer to accommodate for the small amount that will need to be cut off.

Soft Wood

Having nothing to do with the hardness, soft woods are a classification for evergreen type trees that have small needles for leaves. Pine, Spruce, and Redwood are all examples of soft wood species used on guitars. Yew is a dense species of wood, and is technically classified as a soft wood, so again the actual density has nothing to do with the classification. Any tree that is an evergreen and has small needles would most likely be classified as a soft wood.

Soldering Iron

An electric tool that heats a piece of metal so that it can be used to melt solder. Soldering irons come in many different versions, the best of which heat instantly and are hand held. Solder is used in wiring up electric guitars by making the connections between the wires and controls semi-permanent. Solder conducts electricity, so when the connections are soldered to each other, the conductivity is maintained.

Sole

The portion of the plane that rides along the wood when using the hand plane is called the sole. It needs to be flat and smooth for the plane to work at its best level, which can be done by sanding it over a granite plate. If hand planes are going to be a very important part of the shop, it is wise to invest in a good book or two on how to properly care for, sharpen, and maintain hand planes. It is a craft like any other, and it turns a basic plane into a tool capable of amazing woodworking.

Solvent

Another name for thinner, the solvent ingredient in a finish is the chemical that keeps the solid parts of the finish in liquid form. The solids are the parts of the finish that lay on the surface and build up as each coat is applied. These need a way to be carried onto the wood and kept as a liquid until the finish is applied. Thinners or solvents act as this liquid, evaporating away when the piece is left out to dry. Once gone, the solids are all that is left, and they dry hard on the surface.

Sound Box

A common term for the body of the guitar when fully completed. Since the sound comes from this portion of the guitar, it is natural to call it the sound box. The vibration of the top plate caused by the strings, turns something barely audible into something that can easily be heard.

Soundboard

The top of the guitar is called the soundboard, which fits well because it is this plate that is making the sounds that are heard when the guitar is played. A well made and responsive soundboard is a dream to play with, and will transmit every small nuance of touch from the fingers into the air as sound. Soundboards are usually made out of a light but strong material, with Spruce being the top choice for steel string guitars, and Western Red Cedar for classical guitars.

Soundboard Transducer

A type of pickup for acoustic guitars, these look like a heart monitor pad attached to a wire and an input jack. They are attached on the inside of the guitar with a little bit of sticky tape on the pad, and the wires are connected to the input jack on the side of the guitar. When the guitar is played, the vibrations are picked up by this little pad and transferred to the amplifier, where they can be processed and made louder. One of the more inexpensive options for adding electronics to the guitar, a transducer is a quick and easy way to amplify the sound.

Soundhole

An opening on the soundboard, usually around 4" in diameter, which serves as a point for air pressure to regulate itself inside the body of the instrument. If there were no sound hole, the top plate would encounter too much resistance from the sealed air space on the inside. It would not be able to vibrate as freely, which would result in a muted sound. The hole allows the plate to vibrate as much as it needs to, letting the air escape and be taken in as the plate moves. As a general rule, a larger soundhole will make a more treble sounding guitar, and a smaller hole will make a more bass sounding guitar.

Soundhole Clamp

This deep throated clamp is used to secure the bridge for gluing, and is positioned through the soundhole, no doubt inspiring the name. These specialty clamps can be purchased and used, or any long reaching clamp like a cam clamp can also be used with the same results. When making cam clamps for the shop, measure and make three that will work for gluing bridges in place. One should reach from the center of the soundhole to the center of the bridge, and the others should sit on either side and clamp the bridge wings. Measure for these three specifically, and they can be used as soundhole clamps.

Soundhole Inlay

Another name for the rosette, the soundhole inlay is made around the soundhole to dress this area up and make it more appealing to the eye. See Rosette for more information.

Soundhole Label

When a guitar maker produces a guitar, they record all the pertinent information on a label and glue it inside the instrument as a way of cataloging the important details. This label informs the owner about the date the guitar was made, who made it, and what the model and serial numbers are. Handmade guitars should be the same, as a label is the final step of a professional guitar. Labels can be ordered online or made at home, and the process is fairly straight forward for anyone who owns a computer. They can be printed out on parchment paper, which looks like the paper the Constitution was written on, giving the label a traditional and classic look.

Soundhole Pickup

These electronic pickups fit in the soundhole of the acoustic guitar, transmitting the sound to the amplifier. They are made by several companies, and have varying methods of attachment, however all of them position themselves at or near the soundhole. They can come with an onboard pre-amp that needs to be installed on the side of the guitar, or they can be wired directly to an input jack, using the pre-amp on the amplifier for all the sound modification.

Soundhole Reinforcement

The area around the soundhole needs to be braced and reinforced well in order to minimize the amount of vibrations that are lost in this area. A circular graft from a piece of thin spruce is glued around the soundhole on the side with the braces, and is sanded and fitted. This piece adds some mass to the soundhole area, making it stronger and losing less energy while the instrument is played. A spare inexpensive soundboard can be used to make these rings, and several can be cut from one of them. Glue the ring around the soundhole with the grain running perpendicular to that of the soundboard for the strongest bond. Also, using wider and thinner soundhole braces, which are laid flat on either side of the opening, can have a similar effect. Cut these from Spruce as well, and they will help retain vibrational energy around the soundhole, without having to use an entire graft from a second soundboard.

Spindle Sander

A type of machine sander that has a flat table top with a vertical spinning cylinder that is covered in sandpaper. This cylinder can be several different diameters depending on the size needed, and all spindle sanders come with several different sizes. On most of these units the cylinder moves up and down a little bit as it rotates, ensuring that the sandpaper does not become clogged from rubbing on one spot. These are called oscillating spindle sanders when the sanding head moves up and down. They take sandpaper sleeves, and many different grits can be purchased for any type of sanding requirement.

Split Open

Used interchangeably with re-saw or fillet, this means to cut a piece of wood into two pieces by going through the edge of the board. This would take a 12" x 12" x 1" board and turn it into two boards that are both 12" x 12" x about 1/2". This is done for making guitar backs and sides, because the split open board can be oriented into a book match, and will look the best this way. Larger boards can be sawn into smaller boards, saving money by doing the steps in the shop instead of buying them already cut.

Splitting Wood

A general term for cutting a piece of wood along the edge, opening it up for book matching or for making blanks. See Split Open for more information.

Spoke Nut

On some truss rods, the adjustment nut is a wheel shaped piece of metal with several holes around the rim. It is designed to be turned by inserting something into one of the holes and rotating the nut, which adjusts the rod.

Spokeshave

This is a plane iron with two handles that stick out on either side, and is pulled across the piece to remove material. Essentially these are planes with handles that are designed for carving a curved profile like a guitar neck. The blades are both flat and curved depending on which type is being used, but either will make neck carving much easier. Planing is a very efficient way of removing wood, and a well sharpened spokeshave takes much of the hard work out of neck carving. Look for a well made and name brand spokeshave, as the cheap units are usually pretty bad.

Spool Clamp

Mostly used for attaching the plates to the sides of an instrument, spool clamps are basically long bolts with wooden cylinders at each end. A nut at the top is used to tighten the wooden cylinders against the edges of the plates, holding them tightly for gluing. A set of spool clamps can be made very easily from long bolts and a dowel rod, making the entire set for the same cost as a few individual clamps from an online retailer. These can be made to any size needed in the shop, and can be adjusted to suit any thickness of guitar.

Spring Clamp

A hand held clamp with two jaws and a small spring to hold them together. These can be used any time that a little clamping pressure is needed, and a full size clamp would be too much. They are useful when gluing kerfing to the sides, keeping a fret dot from coming out while gluing, and many other smaller tasks around the shop. They are inexpensive, and worth having at least a few in the shop.

Spring Wood

The first growth of the season in a tree, See Early Wood for more information.

Square

This word can refer to two pieces of wood being square, meaning they meet at 90 degrees, or it can refer to the metal tool of the same name which helps accurately place items at 90 degrees. A metal square is a helpful measuring tool, and it is useful for marking straight lines on a piece that will be cut on a saw. These come in large and small varieties, though a 12" - 18" long square will be perfect for guitar making use. A larger square can be helpful in checking to see if the frets are level across the entire board, but the small one will be used the most often for layouts and marking. Purchase a good quality square that has reliable measurements. Sometimes squares found in discount stores have slight issues with their measurements markings, which makes the tool completely useless. A measuring device is nothing if it is not accurate. Spend a little bit on a well made and accurate square because everything made from it will also be the correct size and accurate.

Stacked Neck

An alternative to making a scarf joint, the stacked neck involves using several pieces of wood cut from the same board to glue up a neck blank. Once glued, the profile of the neck is cut out and the rest of the process for making the neck is the same. A stacked neck can be made from a single piece of 4/4 lumber, which saves time and money on materials. The board is cut at the end into two or three short segments that go under that same end, making the blank tall enough for a heel. Also, a longer piece is cut from the other end and glued to the underside, making room for cutting out an angled headstock. This style of neck making is strong, sturdy, and is a great use of resources. It will have the same or better strength as a scarf jointed neck, and will cost far less to buy wood for than a solid neck.

Steam Bending

When super hot steam is piped into a sealed box, heating a piece of wood and loosening the fibers for bending, this is called steam bending. The process is not used much in the guitar making world, however there is

no reason why it should not be if the equipment is already in the shop. A form can be constructed of the side profile for a guitar, the wood steamed, and then clamped to the form to dry. Technically speaking, bending wood on a hot pipe using water is a form of steam bending. The pipe heats the water in the wood, causing it to steam and loosen the fibers, which allows the piece to be bent.

Steel String

A western style large bodied guitar with metal strings instead of nylon is called a steel string guitar, or a western style guitar. These instruments are famous for big sound, which the higher tensions and gauge of the steel strings are to be credited for. The strings allow more tension to be placed on the soundboard, which means thicker and stronger wooden pieces can be used, making bigger and louder instruments. A steel string guitar can easily drown out a classical guitar, and it is a complete mismatch when looking at sheer power. Steel string instruments have stronger bottom ends, and very bright trebles from the higher strings. They also pack a louder voice and can play at a higher volume.

Steel Wool

A fine abrasive used for smoothing finishes, and made from very long metal fibers. The product comes in several grits, though most of them are very fine. They grits used for finishing are expressed in 0's, with 0000 being the finest and 000, and 00 being more coarse. Use 0000 steel wool for any finish leveling, as it leaves the fewest scratches and creates the smoothest surface. Make sure to buy steel wool from a hardware store or fine woodworking store when using it on a finish. The type found in the grocery store will contain soaps and other chemicals, plus it will not be of a consistent grade.

Stop Collar

Used to set the depth on drill bits that are used in a hand drill, a stop collar is a small metal ring that fits over the drill bit and is locked in place with a set screw. These come in sets of different diameters so they can fit easily on any bit size, and they make drilling to a specific depth much easier. These are useful when drilling for the dowels when joining the neck to the body with a dowel joint. Having a stop ensures that the holes are not

drilled too deeply, and that half of the dowel will end up in each hole in the resulting joint. These are also good when drilling holes for inlay dots by hand, as they will prevent drilling too deep, and accidentally inlaying the dot too deep as well.

Straight Bit

A router bit of a consistent diameter, used to make trenches with straight walls and flat sides in pieces of wood. These come in several diameters and lengths, and are useful when routing out control cavities on electric guitars. They are also great at routing out the center seam inlay for the back plate, and for making radius dishes for the go-deck.

Straight Edge

This term is used many times in reference to a ruler, however it means a little more than that. A straight edge is a piece of thin metal, much like a ruler, that is precision ground to be perfectly flat. This tool is used to check the frets to see if they are level, check a piece of wood for divots or doming, and any other time something needs to be checked for flatness. A good quality straight edge is a valuable tool to have, and an indispensable item for fret work.

Straight Grained

The term for any piece of wood where the grain runs relatively straight from one end to the other. This is most easily seen in pieces used for tops, because the grain lines are clearly visible. A guitar top will typically have lines that run from one end to the other, only moving left or right a quarter inch or so. A piece like this would be considered very straight grained, and desirable for guitar making. Straight grained wood tends to be less prone to bending, twisting, or deforming over time, and is more aesthetically pleasing, especially on a guitar top. A guitar neck is best made from relatively straight grained wood, as it will have a smaller chance of deforming or twisting under the string tension.

Strap Buttons

Small metal pieces that are screwed into a guitar and used to attach the strap are called strap buttons. They are most common on electric guitars, but can also be found on acoustic guitars on the heel of the neck.

The other side of the strap attaches to the end pin, which is essentially the same thing except it is made from wood. Buy these in bulk to save money, and they are available in chrome, black, and gold.

Strap Locks

These are more intense than strap buttons, using a locking mechanism to secure the strap to the guitar and prevent it from coming off by accident. These are sold as a set, with one end being screwed into the guitar and the other end being screwed to the ends of the strap. The strap end has a small pin that goes into the part on the guitar, and another pin needs to be pulled in order to allow it to be removed.

String Gauge

The thickness of a wire is referred to as the gauge of the wire. Guitar strings are wires as well, however they are not referred to as being of a certain gauge, because their sizes run far more precise than that. The term is used to talk about guitar strings sometimes, however the sizes are referred to in thousandths of an inch instead of in gauge measurements. There are a limited number of wire gauges, where the larger the number the thinner the wire. However, there are far more string sizes than that, which is why the term is simply used to refer to how heavy the strings are. A heavy gauge string set is thicker than a light gauge string set, and a medium gauge would be right in the middle. Try to use the thickest strings possible that are still comfortable to play, which will torque the soundboard more, and be more responsive to playing.

String Retainers

A small piece of metal designed to hold the strings closer to the peg head, so that the angle over the nut is tighter, and the string terminates against the nut better. These are mainly used on electric guitars with a flat headstock, however on an acoustic with a shallow headstock angle, they can make the break angle over the nut steeper, making the guitar play better. They come in sets of two, each one of them holding two strings against the peg head with a screw in the middle. Any time a shallow peg head angle is used, these can come in handy to restore the proper break angle.

String Spacing

The distance between each string as well as the total distance from the first to the sixth string can be called the string spacing. The strings need to be far enough away from each other that the fingers do not accidentally touch more than one string while fretting, but close enough that the strings can be reached easily. Thankfully this has become somewhat of a standard, and a string spacing of 2-1/8" to 2-1/4" is both playable as well as nicely spaced. Anything narrower would be hard for a person with thicker fingers to play, and anything wider would require larger hands than the average person.

String Winder

This plastic device with a handle goes over the head of the tuning machine and allows it to be turned very rapidly. This makes it easier to wind the strings when first stringing up the instrument. Some string winders have a removable head, which can be chucked into a drill for even faster string winding.

Strings

The long thin pieces of wire that are attached from the bridge to the tuning machines and are plucked to cause vibrations are called the strings. The thickness of the strings will affect how tightly they need to be tensioned in order to meet a certain pitch, and thinner strings will require less tension than thicker strings. There is a balance, as in all things, though a weak sounding guitar can usually benefit from being strung with a little thicker set of strings, driving the soundboard better. Try one gauge thicker, and see if that makes an improvement. They will take a little getting used to, however they will play much better.

Strop

A piece of leather that is impregnated with honing compound and used to finely hone an edged tool is called a strop. These can be manual versions where the leather is stationery and the tool is moved across it, or they can be powered. Power strops rotate on a slow speed grinder much like a grinding wheel, except they are used to hone very sharp edges. The leather wheel is loaded with compound much like the non-powered strop, and the tool is held against it. A strop is useful to switch to after initial

sharpening, as it will refine the edge further and make it incredibly sharp. Stropping is one method of honing a fine edge, and is one of the simplest.

Summer Wood

The tree growth that occurs later in the growing season, See Late Wood for more information.

Sun Burst

A finishing technique where several layers of color are used, gently taking the coloring from lighter in the middle of the guitar to completely black along the outside edges. This requires spraying equipment in most cases but can be done by hand with linseed oil and artist pigments if done carefully. More common on electric guitars, a single shade sunburst using blue or red that fades to black is great looking on an acoustic guitar. Test the technique out on a piece of wood if doing this by hand, in order to get the technique down. Once the test board comes out nicely, the finish can be attempted on the guitar.

Super Glue

Super glue is the common name for CA glue, or Cyanoacrylate glue. See CA glue for more information.

Sureform

Very handy for carving necks, this metal carver looks like a cheese grater, and removes wood very aggressively. The tools come in a few configurations, however the 1-1/2" wide and about 12" long tool with the yellow handle is the best for carving neck profiles. This tool removes wood with a vengeance, and can be followed up with a regular wood file, and then finally a scraper to get a smooth surface. Carving a neck by hand can be a bit tiring, but this tool can completely rough out the back side of the neck in a few minutes, which is far better than using a regular file for the same job. This is a great tool to have in the shop.

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Table Saw

A power tool with a vertical spinning blade of several inches in diameter with a metal table top and accessories for feeding wood into the blade safely. The table saw is one of the pillars of woodworking, and is used mainly to rip cut material, though it can crosscut as well. The circular blade can be adjusted for height, tilted on an angle, and fences are used to make sure cuts are made evenly. The table saw is a useful tool, especially for splitting open boards without a band saw that has re-sawing capabilities. The table saw can also rip small strips for making bindings, braces, and many other parts of the guitar.

Table Saw Insert

A piece of plastic or cast resin, the table saw insert sits in a recess on the table top, surrounding the saw blade. It is removed for access to the blade itself and for changing blades. These come with narrower and wider openings for the blade, depending on what the saw will be used for. There is a regular opening, a zero clearance opening that has almost no gaps on either side of the blade, and a dado opening for the wider dado blade set. A zero clearance insert is useful for making binding strips on the table saw, and can be made in the shop fairly easily. If not made, they are inexpensive to buy, and are very easy to install and cut for the first time.

Table Top

Any flat metal piece on a power tool where the pieces of wood are rested as they are cut or shaped is called a table top, or table for short. These allow the work piece to be rested while being cut, and some of them can tilt or adjust for cutting on angles. All table tops should be maintained by keeping them clean and free of water or liquids being left on the surface. Any rust or pitting should be addressed immediately so that the problem does not get worse, and there are products on the market for this purpose.

Table Top Model

This refers to tools that are sized for the bench top, and are essentially smaller versions of the larger floor standing models. See Bench Top Tools for more information.

Tack Cloth

This is a piece of cheesecloth usually that has been dipped in a sticky substance and wrung almost completely out. They are stored in plastic baggies to keep them from drying completely, and are used for wiping sanding dust from the surface of a piece before applying finish coats. Tack cloths can be made in the shop and kept in a jar in order to keep them moist, or they can be bought at a woodworking store. A damp rag will do about the same thing, and should be tried before buying any tack cloths. The rag may raise the grain, which will need to be sanded down, but this step should be done anyway. The tack cloth is basically a sticky piece of cheese cloth, that grabs all the dust and debris before finishing the wood.

Tack Hammer

A small headed hammer with one side a little larger than the other, and the smaller of the two heads is magnetized. This is a light weight hammer that is great for starting the ends of frets if used lightly, and is perfect for hammering in small nails.

Tail Block

Inside the guitar, this block is located at the lower bout where the sides meet. The sides are glued to this block, and the end pin is drilled through it. A solid end block gives the sides something to attach to, as well as provides some reinforcement at the bottom of the guitar. The blocks should be made out of the same material as the sides if possible, though not absolutely critical. Mahogany makes an excellent end block, and does not add any undue weight to the guitar. Also, it is preferable to match the direction of the grain of the tail block to the grain direction of the sides. This way they will expand and contract in similar amounts as the humidity changes, reducing the chance of cracks and splitting.

Tail Piece

Used with floating bridges as in arch top guitars, the tail piece is attached to the end pin of the guitar and serves as the holding point for the

ends of the strings. Most moveable bridge instruments like the arch top guitar, jazz guitar, violin, and cello, all have a tail piece to hold the ends of the strings as they stretch over the bridge and towards the nut. These can be made from metal, wood, or plastic, though the best tail pieces are made from highly polished and well selected Ebony wood.

Tail Piece Strap

This small cable connects the tailpiece to the end pin by being threaded through the tail piece and wrapping around the end pin.

Taper

Sometimes used to describe a taper reamer, or a shape that starts out large, then evenly on all sides becomes smaller along its length. See Reamer for more information.

Tear Out

When working with wood, and a machining process rips grain fibers out of the wood in random places, this is called tear out. The problem with tear out is that the wood looks very uneven and it ruins the look of a nice board. The holes will have to be filled or sanded through until the surrounding wood is all removed, leaving a level surface. Many times a cabinet scraper can remove most of the wood in that area, making the tear out not look as noticeable, however sometimes it just has to be filled before finishing. Running wood through a planer against the grain or by taking too deep of a pass can cause tear out. Also, using high grip tape when taping the binding strips to the guitar can tear the grain out of the top when removed.

Template

A piece of pre-cut and shaped wood that is used as a guide for making accurate cuts and parts is, called a template. These can be made from plywood or MDF, and are typically used to cut something else out of another piece of wood. For the router inlay kit, a template of the shape being inlaid is used for both cutting out the inlay piece as well as carving out the cavity. Extra care must be taken when making a template because everything made from it will only be as good as the template itself. A poorly made and inaccurate template will make pieces that are also poor quality and inaccurate. Make the template correctly, and it will yield

accurate and well fitting pieces that will be well worth the extra time spent on the template.

Template Bit

This particular router bit is a straight bit with a bearing on the top near the shank. The bearing rides against a wooden template while the rest of the bit removes material below. These are great for routing neck cavities in electrics as well as bolt on acoustics, and for routing pickup cavities.

Tenon

When making a mortise and tenon joint, the tenon is the part that sticks out and goes into the mortise. This is a very strong alternative to a dovetail joint, and is a little easier to make. The dovetail is still the primary joint used in guitar making, however a mortise and tenon is a close second.

Tentalones

Kerfing strips are really an advancement on an old technique in order to make it faster and easier to complete. The original way of reinforcing the joint between the sides and the top was to cut out hundreds of little wooden triangles and glue then in one at a time all around the rim. This was quite a project, requiring lots of time and patience. The kerfing strip has greatly reduced the time it takes to reinforce that joint and the results are similar. In the time it takes to make several hundred tentalones, many kerfing strips can also be made, which are going to be easier to install, and perform the same action.

Thermoplastic Creep

This is the phenomena where a dried glue joint will move over the years a very small amount, leaving a ridge where a very flush joint used to be. It has to do with the fact that there are things in the glue that never fully harden, allowing changes in moisture and tension between the surfaces to eventually cause a shift in the glued joint. Titebond is not free from creep, however their formulations are very resistant to it, making it still a very good choice for woodworking and guitar making. One of the fantastic properties of hot hide glue is that it hardens so much that it does not creep

at all. Any time thermoplastic creep is a worry, use hide glue for the joint, and there will be no creep what so ever.

Thickness (A Piece Of Wood)

The act of making a piece of wood a certain thickness for use in guitar making. A thicker piece is fed into a planer or planed by hand until it is the correct thickness for use on the guitar. Sides, backs, and tops all have a certain thickness they need to be brought down to in order to be effective, which involves using a plane of some kind.

Thickness Planer

Also called a machine planer, or Planer, this machine is used to make reducing the thickness of a piece of wood very fast, accurate, and easy. See Planer for more information.

Thinner

A chemical in liquid form that dilutes a finish so that it can be sprayed or wiped on a project without drying too quickly. See Solvent for more information.

Threaded Insert

A small round metal piece that has large threads on the outside and machine screw threads on the inside. The unit is screwed into a pre-drilled hole using an allen key normally, and then a machine screw can be screwed into it. These are used on the body mold to attach the back arching template, as well as on bolt on necks. The threaded inserts are set into the heel of the neck and then bolts are sent through the head block. These come in many sizes depending on the application and can be used on jigs as well. They are very useful to have around and can be found in any hardware store. Make sure to buy inserts that are the same thread pattern as the screws being used.

Threaded Rod

Another name for all thread, threaded rod is basically a long machine screw without a head, that comes in lengths as long as several feet. See All Thread for more information.

Tie Block

On the classical guitar, behind the saddle there is a long portion of the bridge with holes in it called the tie block. This is where the strings are tied to when stringing up the guitar. They can be plain wood or they can be inlaid with Abalone or Mother of Pearl for embellishment.

Titebond

The name brand of the most popular woodworking glue in at least the United States. A type of AR glue, Titebond is sold in various sizes from a few ounces to several gallons. Titebond Original Wood Glue is sold in a bottle with a red label, and should be the glue used for all wood to wood joints on the guitar, unless hot hide glue is going to be used. The joint made by Titebond glue is stronger than the wood itself, and when flexed the wood will break before the glue goes. It sands easily, wipes off while wet with just a damp rag, and makes joints that can hold up to stress and pressure. It is easily the premier glue for woodworkers and instrument makers in America and around the world.

Tone

Tone refers to the quality of sound that a guitar produces, and there is good tone as well as bad tone. It is a very subjective term, and what one person would consider to be good tone, someone else might not. However, there is a general consensus about what a good guitar should sound like, and this can be learned by playing several good sounding guitars. Go to a music store and play an expensive acoustic guitar and get a feeling for what it sounds like, then pick up another and do the same. Make sure they are the same style that is going to be made in the shop, so that the sounds being heard are the sounds to hopefully hear from the handmade guitar. Listening to acoustic guitar music can also help train the ear to know what good sound is, though there is no substitute for playing an instrument first hand.

Tone Bar

Another name for braces, the tone bars are the wooden pieces that are under the soundboard and on the inside of the back plate. See Braces for more information.

Tone Rite

This is a brand name for a product that simulates playing the guitar in order to get the instrument to sound like it has been played for a very long time. Guitars that have been played for many years just sound better than new guitars, so the theory is to use a small device that will simulate playing the guitar, in order to age it a little faster. The unit is left on the guitar for several hours or a few days, and this simulates months or years of playing. The instrument has a more worn in sound when the session is complete, and will start to sound like a well broken in guitar.

Tone Wood

Wood that is especially cut and packaged for guitar making from specific species is called tone wood. This term simply means wood that is destined to be made into instruments, and has nothing to do with whether or not it will sound good. Wood collected from a pallet that is sanded nicely and cut to shape for guitar making can be called tone wood as well. Wood purchased from a hardwood store, though not labeled as tone wood, and is the same exact species and can be the same quality as well.

Tool Steel

A much stronger steel that holds its edge better than regular steel is tool steel. It is harder than regular steel, so the edges of sharp tools are maintained for longer periods before having to sharpen them. Tool steel can come in many different alloy mixtures, but it is always a better choice for hand tools than plain steel, which is used on very inexpensive tools.

Toothed Plane Iron

A plane iron that has had several notches filed into the blade at regular intervals to reduce tear out and make the plane work more smoothly, is called a toothed plane iron. These are available from many suppliers as replacements for specific blade sizes, and they are easy to switch in and out if using a hand plane to thickness the plates. These will reduce tear out from alternating grain direction, and since they remove a little less material, they are easier to push around without getting stuck.

Top Diamonds

Also called top buttons, these small square pieces of spruce are used to reinforce the center joint on the soundboard. These are around 3/4" by 3/4" and have beveled edges. They are attached with glue to the underside of the top with the grain running perpendicular. Two of these are typically used, and they go on the lower bought, right over the center seam.

Tortoise Shell

Not made from actual tortoise shells, this actually refers to a pattern in picks and pick guards that is a swirl of red/browns and amber. It is commonly found on pick guards, and is a very nice looking material.

Treble Side

Looking at the top of the guitar, the half that has the higher strings would be called the treble side of the instrument. The treble strings are on this side, which is why it is called the treble side.

Tremolo

Mostly found on electric guitars and arch top guitars, a tremolo allows the player to pull or push a lever that increases or reduces pressure on the strings, bending the notes sharp or flat. These come in many shapes, brands, and configurations, though the idea is that a hand held bar is used to change the string pitch, and springs installed in the guitar restore the strings to standard playing tension.

Tripoli

This is a very fine abrasive that comes in powdered form as well as bar form. The bar form is applied to buffing wheels and used to remove minor scratches in metal and wood. The powdered form is mixed with a wax or water and rubbed by hand on the surface of a cured finish, raising the gloss. This is normally one step in a several step polishing process.

Tru-Stone

Tru-Stone is a man made composite material, which is comprised of ground up rock and epoxy resin, which forms an amazing looking blank that can be used for inlaying. These have the look of real stone and the workability of a hard wood. Originally designed for pen turners, the material can be cut with standard tools and does not dull them

more than working with wood. They come in a variety of colors and designs, often mixing gold or silver veins into a background that looks like natural marble. These can be sliced carefully with a saw into thin blanks and then pieces can be cut from them. It is a dense enough material that nuts and saddles could be feasibly made from it as well, which would make them an absolutely beautiful part of the guitar.

Truss Rod

The truss rod is a metal rod that goes inside the neck and runs the full length. It is set up so that with a turn of the attached nut, the rod will bow backwards with a large amount of pressure. This pressure forces the neck backwards, which counteracts the tension of the strings. Truss rods are used to straighten out a neck that the strings have bowed, and to make the neck more rigid. Though they can be bought from online supply houses, they can also be made fairly easily in the shop.

Truss Rod Cover

A small decorative cover that goes over the end of the truss rod, a truss rod cover is usually found on the headstock of the guitar. With truss rods that adjust at the neck, the truss rod nut needs to be covered up so that the guitar has a more professional look to it. A small bell like cover plate with a few screws is used to cover the opening, and these can be made of wood or plastic. Custom truss rod covers can be made in the same way as custom pick guards, from a few sheets of veneer all glued together into a single hard layer. The truss rod cover shape is then cut out and the edges sanded before installing.

Truss Rod Nut

The small nut used to adjust a truss rod, which causes the rod to flex and bow the neck backwards. These are normally hex nuts that are a little longer or domed to look a little nicer than regular hex nuts.

Truss Rod Slot

On the neck itself, the long skinny slot that holds the truss rod is called the truss rod slot. This can be cut with a router and a round bottom bit, or cut with a table saw leaving a square bottom. A sharp knife and a chisel can also create the trench, though it will take a little longer. Typically

the slot is as deep as the rod is tall at the headstock end, and a little deeper at the soundhole end. This is because the rod will need a bit more clearance for the bearing nut at the soundhole end than it will at the headstock end. Plus it keeps the most wood at the headstock side, making the head stronger and less susceptible to breaking off.

Truss Rod Wrench

A special wrench that is essentially a socket welded to a metal handle that is used to turn the truss rod nut and adjust the tension of the rod. The socket is a little thinner to help get into the truss rod cavity easily, and it can help when a regular socket cannot fit.

Try Square

Used primarily for marking 90 degree angles and for extending pencil mark lines the full length of boards, the try square is a small square, shaped like the letter L. One side has a regular steel ruler on it with measurement markings, though sometimes it is just a plain metal blade. The other end is made of wood, and bolted to the end of the metal blade. A small pencil mark is made on a piece of wood, then the try square is used to elongate it for more accurate cutting. A try square is useful for squaring the bridge to the center line of the guitar top, and makes it easier to mark out the location for gluing. It is difficult to stand back and eyeball the bridge alignment, so the try square is very handy.

Tuners

A short name for tuning machines or guitar tuners, See Tuning Machines for more information.

Tung Oil

A popular ingredient in finishing products, this oil is obtained from the crushing and processing of the seeds from the Tung tree. The resulting oil is then refined and bottled as pure Tung oil or mixed with other finishing ingredients to make a better performing finish. Tung oil finishes may not actually contain Tung oil at all, or perhaps only a tiny fraction of it. Manufacturers have caught on that people like the name, so they call any finish that looks the same a Tung oil finish. Like Linseed oil, Tung oil does not like to dry without help from added driers, so look for a Tung oil

mixture that has some other ingredients in it to help speed up the drying process.

Tuning Machines

Used to control the tension in the strings of the guitar, tuning machines come in a variety of styles, shapes, and colors. Essentially they are a manual knob with a gear and a post. The post rotates, which winds the string around it, holding it in place. The tuner is then turned to a certain position where the string is tensioned to an exact note. Tuning machines go in the peg head through pre-drilled holes, and attach on the back with screws. Some attach with pressure from a bushing on the top that is threaded, but most will have at least one screw on the back of the peg head. The type and style of the tuning machines can really set off a guitar. Spend a couple dollars extra on a nice quality set of tuners and the guitar will play better, stay in tune longer, and look better. Tuners that lock after the strings have been adjusted to a certain note can also be used, and they make staying in tune much easier.

Tusq Material

The name brand for a high end nut and saddle material used for guitars that want a vintage or authentic looking nut and saddle, but do not want the inconsistencies and inferior tone transfer that natural materials have. Tusq is said to be the perfect material for making nuts and saddles out of, because it helps transmit energy faster as well as enhance harmonics produced while playing.

Twist Bit

A twist bit drill is the standard type of drill bit, where the tip comes together in a spiral, and there is a blunt point in the center. This kind of bit tends to move around when used on wood, especially if the wood is soft and easy to bite into. A better set of drills for guitar making would be the brad point bits or Forstner bits, because they drill exactly where they are supposed to.

Two Part Epoxy

Sold in two bottles, one with resin and the other with hardener, two part epoxy is a hard drying clear adhesive that is used for inlay work. It

is essentially all solids when mixed and poured, and the hardener chemical begins the process of drying and hardening into a solid form. There are several types of epoxy that are available in stores, though a 30 minute clear drying epoxy will work the best for most applications.

Two Way Truss Rod

Not to be confused with a dual action truss rod, the two way truss rod can be used to bend a neck backwards or bend it forwards, correcting any problem found in the neck. The need to move a neck forward is not as prevalent as needing to move it backwards, though these kinds of rods will do both quite well. The bent over rod, or dual action truss rod is still the standard for acoustic guitars.

-U-

Under Saddle Pickup

A thin metal pickup that is installed under the saddle of the guitar, picking up vibrations from the strings as they are played and relaying the information through a pre-amp. This item is easily installed in an existing guitar with a little routing, or can be fitted into a handmade guitar with a little extra planning for the depth of the saddle slot. The pickup itself is around 1/8" thick, and that much extra space will be needed in the saddle slot. The pickup goes in first with a small hole drilled for the control wire. The saddle is placed over the pickup, and the strings transmit the vibrations to the pickup, and then the amplifier.

Up Cut Bit

On a spiral cutting router bit, the type where the rotation forces the material upwards is called an up cutting bit. This would make a clean edge on the bottom of the material but leave the top a little more fuzzy. These are the standard type of spiral cutting bit, and are not the preferred bit to use for inlaying and cavity routing. A down cut bit is the best, and if one is to be purchased, make it a down cut. See Down Cut Bit for more information.

Upper Bout

The portion of the guitar that is nearest to the neck, including the shoulders and the area of the soundhole is called the upper bout. It is everything above the waist, including the shoulders. The upper bout may have a cutaway or may not, and is where the upper horizontal brace is located.

Upper Face Brace

This is the horizontal brace that goes right above the soundhole that typically hits the sides just below the maximum width of the lower bout, or right on it. It is called by many names, including the horizontal brace, upper brace, main horizontal brace, and upper face brace. All of

these refer to the same thing, which is the large brace just above the soundhole.

-V-

Vacuum Clamp

Used more in professional shops, but finding their way into smaller outfits as well, vacuum clamps use vacuum pressure and thick plastic to clamp pieces of wood together while the glue dries. These are not meant for dishing out hundreds of pounds of clamping pressure, but they can easily hold braces to the soundboard, and inlays into the fingerboard. These come in various sizes, and can speed up production work.

Varnish

When an oil and a resin are heated together they form a completely new substance which is called a varnish. Varnish is mixed with thinner to make it easier to apply and extend the drying time for better leveling. Varnish is a hard wearing substance that coats the guitar with a protective layer that keeps out moisture, grime, and oils from the hands. An easy to apply type of varnish is called a wiping varnish, which is a varnish and a large amount of thinner, which makes it easier to apply with a cloth, and take longer to dry. The extra drying time ensures that the finish will self level before hardening, making streaks and swirls less of a worry.

Veneer

This is a very thin sheet of wood, about the same thickness as several sheets of paper. Veneer is made by rotating a log on a machine, and using a long blade to carefully cut a thin sliver of wood that looks like unrolling a giant roll of toilet paper. This sheet is cut to certain lengths and then stacked and packaged for sale. Veneer can be used on the guitar for custom made pick guards, handmade picks, and for peg head overlays. It can also be used in soundhole rosettes, and for other decorative inlays.

Veneer Glue

Veneer glue is a special glue that is designed not to seep through the thin veneer sheets as much as regular glue would, though it is not a huge issue with the kinds of veneer gluing guitar makers work with. A veneer glue will also dry completely, and not creep over time like AR glue. Though

again, for a guitar maker, this is not going to come up on such a small scale. If thermoplastic creep and glue squeeze through are things that keep you awake at night, feel free to use veneer glue for the pick guard project in this book.

Veneer Press

Used for gluing and pressing veneer, it is a press with large flat cauls to keep the veneer flat while it is being glued. For guitar makers, this can be as simple as a couple pieces of 3/4" MDF that are 12" x 12" and sandwiched between some gym weights. For making custom pick guards as well as picks, this is a very adequate press size, and will work perfectly. Make sure to cover the faces with some wax paper before clamping everything together. This way any glue squeeze out will not touch the cauls, and glue the whole pile together. If this happens, the entire press setup will be ruined, and a new one will need to be made.

Veneer Roller

A hand held roller that is used while veneering a larger area, to apply pressure to the veneer and squeeze out any extra glue while also flattening any bubbles. Unless a large number of pick guards are going to be made, the likelihood of needing a veneer roller is quite low. However, it is a great tool if a larger piece is going to be glued up.

Vernier Caliper

A hand held non-digital caliper that has markings on the slide which are read to determine the size of the item being measured. These are not like a dial caliper that has a large dial that can be read. The information is on the slide itself, and is read directly off of it. A basic Vernier caliper is nice to have in the shop because it can be used to take accurate measurements with far more precision than a ruler could ever hope for. Especially when measuring things like drill bits, string spacing, and other items that are hard to measure accurately with a ruler, the caliper makes a big difference.

Vertical

When something is oriented in a North and South direction, or as a tree grows, this is called vertical. It is horizontal rotated 90 degrees,

and would be perpendicular to a horizontal plane.

Vise

Used to hold objects while they are being worked on, vises come in many sizes, shapes, and functions, depending on what they are needed for. See Front Vise and Pony Vise for more information about vises.

Vise Faces

Inside a vise, the parts that come together and hold onto the piece are called the faces. Sometimes called the jaws as well, the faces of the vise can come in different shapes, though they are usually squares or rectangles and made from a softer material than will be clamped. The reason for using softer vise jaws is so that they do not scratch or mar the surface of the guitar while it is being worked on. A front vise will have metal faces that can be covered with wood. It is recommended to do this before anything is clamped in the vise.

Vise Grips

A hand tool that is similar to a pair of pliers, the vise grips has a clamping feature to them that allows them to grip and hold something tightly. The advantage here is that it frees up both hands more than if one had to maintain constant pressure on the pliers. These are useful while making jigs, to hold pieces down to the drill press table, and for many more tasks. Not much more expensive than a pair of pliers, a vise grips is always handy to have around.

-W-

Waist

The part of the guitar near the soundhole that bows inwards on each side towards the center of the top. The waist is the most difficult bend when making the sides, which is why it is typically done first. Should there be an issue, the rest of the piece is not already bent, and it is easier to bend the upper and lower bout once the waist is correct. Orchestra models and standard guitars have tighter waists than Dreadnought guitars, which is part of the style.

Walk (Drill Bit)

This happens the most commonly with a twist bit, where the drill does not go into the wood exactly where it is supposed to, and moves a little in one direction before finally digging into the surface. This is called walk, and is common when drilling softer woods. A brad point or Forstner bit has small points at their centers that dig into the surface very quickly, virtually eliminating drill bit walk.

Walnut

Walnut is a great type of wood to use for making guitar backs, sides, fretboards, and peg head veneers from. It is a large tree, growing in the eastern portion of North America, particularly in the US. The grain is interesting looking, and can be dyed to resemble Rosewood. This wood has a pleasant smell when working with it, though it can cause allergies in some people. It works well, bends well, and finishes exceptionally well.

Warmth

A way of expressing the tone of a guitar or other instrument, and is generally referred to as a pleasant wholeness to the tone. An inviting and attractive feeling from the sound can also be called warmth. The term will mean different things to different people, but when it is felt and heard it is easily understood.

Water Base

In an effort to become more environmentally friendly, finish manufacturers have begun to make finishes that use water as their thinner. These finishes have far less environment harming chemicals in them, and are becoming better and better as their formulations are being perfected. They still cannot give the amber glow that an oil can, however they are a viable alternative to guitar maker who wants to use more earth friendly finishes. It is debatable how much damage a small guitar shop can possibly do to the earth, even if several guitars are made per year. However, these alternative materials are out there for a reason, and nobody should be afraid of trying them out.

Western Red Cedar

The traditional choice for classical guitars, Western Red Cedar has a warmth and a tone that lends itself to the lighter string tension of a classical guitar. The tree itself is very large, and native to western North America. These soundboards have more warmth than Sitka soundboards, which are brighter and respond more to the treble strings.

Western Style Guitar

A catch all name given to almost any steel string guitar. This includes all shapes and tunings, as long as they are flat topped steel string guitars. See Flat Top Guitar for more information.

Wet And Dry Sandpaper

A special type of sandpaper that holds together when wet, and can be used to polish the finish on an instrument. It can also be used to sand the surface of a piece while there is oil on it, making a slurry that fills the pores. This kind of paper is usually made in the finer grits, which is perfect for sanding finishes with water or soap, as well as sanding with oil.

Wet Wood

Wood that has been freshly cut or preserved in some manner so that the original moisture content of the piece is retained. This will be a very high moisture content, and is not suitable for making guitars from at all. Be wary of specialty woods that are sold as turning blanks. These are waxed on the ends to keep the moisture in them, which makes it easier to turn them on the lathe. Most of these will crack and split into pieces if the

wax is removed and the piece is left out to dry. If made into any guitar parts, they will shrink and crack over a few days to a few weeks, making them completely unusable.

White Diamond

An abrasive compound that is used after Tripoli to further smooth out the finish is called white diamond. It is made from very fine particles that are suspended in a cake form, which is easily applied to the buffing wheel. It is finer than Tripoli but not as fine as jewelers rouge.

Wood Burning Tool

There are several different styles of these made, however they all use some sort of heated tip that burns wood on contact. This allows the user to hold a pen shaped device and create designs as well as drawings directly on the wood. The very hot tip burns the wood to a certain degree, depending on how long contact is made, and different tips are available which help the artist accomplish more detailed designs. A very basic wood burning tool is not very expensive, however the design capabilities are also very limited. If wood burning becomes something that will be incorporated on many guitars, a higher end unit like the Detail Master is well worth the money. Wood burning can be used around the rim, on the top, or back, to trace over floral and vine patterns, or to create custom designs free hand. The back of the neck, the headstock, and the rosette, can all be embellished with the wood burning tool. The only limit is the imagination.

Wood Dough

Another name for wood filler, See Wood Filler for more information.

Wood Filler

The common name for a putty like substance that is used to fill in cracks and dents in wood, making the surface flat before finishing. In guitar making, this is used primarily to fill the pores before finishing, and nothing more. Wood filler should not be used too much on the guitar as far as a hole filler because it will stand out when the instrument is finished. Some small cracks can be repaired this way, however it should be avoided if at all possible.

Wood Glue

The generic name given to Aliphatic Resin glue, more commonly known as AR glue. This is the yellow glue used in woodworking. See Aliphatic Resin Glue for more information.

Workbench

Consisting of a hard table top made from wood and held up by strong and sturdy legs, the workbench is the cornerstone of the shop. This where the majority of the work on the guitar will take place, and it is well worth the time to build an adequate workbench if one is not available. They can easily be made from 2x4's and plywood, and will make the guitar making process much easier. They can also be bought, but for less than a quarter of the price, a very sturdy and long lasting bench can be made in a weekend.

-X-

X-Brace

Invented by C. F. Martin, the X-Brace revolutionized the sound and playing style of the steel string acoustic guitar, and is widely accepted as the standard today. Instead of using parallel braces or ladder style braces, two very large and long tone bars are configured into the shape of a X, and glued directly to the underside of the soundboard. The legs of the braces help transmit vibrations around the surface of the soundboard, as well as stiffen the soundboard. The strength gained from the X-Brace helps keep the soundboard from bulging due to string pressure.

-Y-

Yellow Glue

Another name for AR glue or wood glue. See Aliphatic Resin Glue for more information.

-Z-

Zero Clearance Insert

Used on the table saw, the zero clearance insert replaces the standard table saw insert with one that has barely enough room for the saw blade to fit through. This makes it easier to saw very small or narrow pieces without them falling through the saw and becoming caught. It is much safer than using a standard insert where the piece could fall into the well and take a couple fingers with it.